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Atlas of the Historical Geography of the United States. By C. O. PAULLIN. With 166 plates comprising over 620 separate maps. xiv and 145 pages; text; index. Published jointly by the American Geographical Society and the Carnegie Institution of Washington and distributed by the Society. 1932. $15.00.

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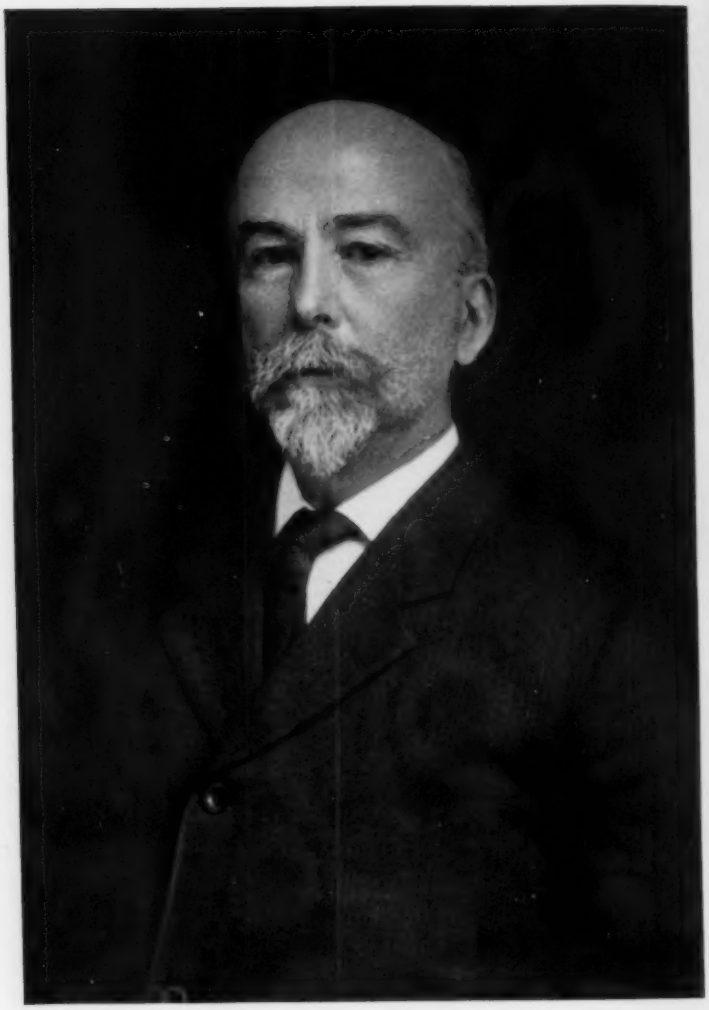

WILLIAM MORRIS DAVIS

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THE GEOGRAPHICAL REVIEW

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WILLIAM MORRIS DAVIS

ONE cannot speak of the "loss" of Professor Davis. His interpretation of the Grand Canyon, a favorite theme, had the monumental quality of the Canyon itself. His brilliant analysis of fault-block mountains is a part of the permanent history of the development of thought about mountain sculpture. He made the use of block diagrams universal by a unique combination of analytical power and graphic skill that continued to the end with marvelous delicacy and firmness of line and with inimitable composition. To the coral-reef problem he contributed a classic that will forever associate his name with those of Darwin and Dana, for, like them, he combined minute and widespread observational detail and generalizing power. In trying to see through to the end of a problem he was always aware of the limits of one man's thought. He once said that he would like to return to earth a hundred years after his death to see how much of "The Triassic Formation of Connecticut" had stood the test of a century's criticism.

Professor Davis was one of the exceptional men whom Shaler inspired and gathered around him in a time of great personalities. "The Coral Reef Problem" is dedicated to "my teacher at Harvard sixty years ago . . . who opened the door of opportunity through which my life work was entered upon." It was a vital personality that passed through that door. His incessantly inquiring mind, schooled in astronomy, geology, meteorology, and physiography, eventually drove toward a single goal, the analysis of land forms. Through contributions of the highest order of originality and of great vigor and variety of thought he became a world figure in his profession. Students came to him from all parts of the country and from abroad. Mountains were living things ever afterward to the person who once heard Davis explain their forms in terms of "process, structure, and stage." He accomplished his purpose not only by fascinating expositions of fact and meaning but also largely by confining the attention to "relevant detail," and he underscored the phrase. It was a singularly dull man whose candle was not lit by the end of the first exercise!

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There was a relentless quality to the Davis discipline. He looked for steel and a spark, and his classes not infrequently declined in numbers as the year advanced. "Great stuff if you can stand it," was the comment. Complacent, slipshod, and uncritical work did not receive from him the coddling approval that self-expression demands in some of the schools of a later day. He believed in the virtues of discipline, and his specializing students were treated as disciples. He looked for the word in their work. The generally descriptive or eloquent line that had no bearing on the analysis was firmly blue-penciled. It was argument and fact that he wanted, not emotion. The "hyperbolic peroration" that referred to the Californian Coast Ranges as a province where "boreal zones boon the summer with zephyrs" left him unmoved. Strangely enough, this rigorously scientific mind turned often to the writing of verse, in which there was good description and sometimes deep feeling. His last address, given before the American Association for the Advancement of Science, in Boston, on December 28, 1933, was entitled "The Faith of Reverent Science."

On one New England field excursion he commented humorously on the care with which he was guarding the dust on his boots, accumulated during the previous field season in the Green River basin. He wore them again in Turkestan on the Pumpelly Expedition of the Carnegie Institution. Before the dust of one expedition was brushed off he was planning another, and whether near or far mattered little if only the field available offered material for the analysis in which he was engaged at the time. The variety and scale of his enterprises were unpredictable. Clear Lake, California, and the bearing of its analysis upon the question of stream antecedence were as important as the whole of Polynesia in coral-reef analysis. He could concentrate as keenly upon the Contoocook Valley of New Hampshire as upon the desert cycle of erosion. Sustained intensity of thought supported by great physical and nervous strength enabled him to push both field inquiry and analysis beyond the usual limits. There was no dawdling over anything; he "attacked" a problem.

As a Quaker he abhorred physical strife as strongly as he liked to strive mentally with his fellow man. He was a true grandson of Lucretia Mott, ardent emancipationist. In the chapter on the United States in Hugh Robert Mill's "The International Geography" (1899) Davis wrote: "Better that the plain [Southern Coastal Plain] should never have grown a pound of cotton, better that its fertile strata should never have emerged from the waters of the sea, than that slavery and its direful, long-lasting consequences should have come upon the United States" (p. 747). In "A Retrospect of Geography," published in December, 1932, he writes of that "advantageous event," the American Geographical Society's Transcontinental Excursion of

1912, which enabled so many international friendships, interrupted by the World War, to be promptly resumed. But the fighting spirit is forward in "The Sculpture of Mountains by Glaciers" (1906) with a memorable paragraph entitled "A Fallacy Leading to a Quandary." The "conservatives" who would yield nothing to ice erosion in regions of cirques and hanging valleys are asked to explain how a "conspiracy of agencies, not now known, prophetically selected all those mountainous regions that were afterwards to be glaciated, worked upon them in essentially the manner that glaciers would work if they could, and then withdrew into obscure inactivity." He concludes that no agency could possibly be so "circumspect." The trenchant phrases bring back Davis in his most aggressive and effective style.

This is not the place to appraise the scientific publications of Professor Davis. But his writings were so much the man and his career that a few of them should be singled out for mention even in this brief notice. "The Rivers and Valleys of Pennsylvania" (1889) opened a new chapter in the analysis of earth features. The parts of an intricate drainage system were related to both rock structure and the evolution of the landscape. "Peneplain Davis" was an affectionate expression among his students thereafter as a result of the publication of "The Peneplain" (1899), written in reply to Tarr's criticisms. However modified, the basic idea has met the most rigorous field tests over the intervening thirty-five years. The concept of the "cycle of erosion," with its dry-climate variant for desertic regions, has stood perhaps as wide and critical examination as any generalization in science. The most analytical attacks yet made, while presenting novel and useful modifications of the idea, leave the special cases within the framework that Davis provided.

The young man who specializes in earth science will be forever indebted to Professor Davis for "the refreshing juice of explanation" that begins to flow as he follows Davis' interpretations; not so much for the conclusions as for the critical attitude of mind that is revealed. The "conscious use of mental powers" led him to emphasize the neglected deductive method and the careful selection of relevant features. Those who thought that he leaned too heavily on deduction forgot his devotion to field work. It was because he found students using their minds aimlessly that he sought deliberately to confine their efforts now to one and now to another mode of analysis consciously employed. He was affectionately devoted to Grove Karl Gilbert, and his biographical memoir of Gilbert for the National Academy of Sciences is one of the finest analyses of method and mental process in scientific literature, a work truly worthy of its subject. If Gilbert's "The Inculcation of Scientific Method by Example" has led to higher standards in scientific work, so too should Davis' com-

ments on that paper; and they should be recalled to every worker in science, and not alone to geologists and geographers: the teacher "will do better to contract the phenomenal, and enlarge the logical scope of his subject, so as to dwell on the philosophy of the science rather than its material." After reading an analysis of the "scientific guess as a mental process" one should turn to Davis' comment on "the high standards of impartial objective research" and the conclusion that the thoughtful student will be led thereby to awaken the generous elements of his nature and "to guard against egotism and selfishness."

A manuscript on the analysis of land forms submitted to him late in 1925 referred to the work of Powell, Gilbert, Dutton, and Davis. It ascribed to Davis more credit than he wished to take for the development of physiography. He edited a paragraph to read as follows, and we here italicize the reference to himself: "Powell's work was noteworthy for the forceful ideas it conveyed of base-leveled surfaces; Gilbert and Dutton excelled in their analyses of individual features; Davis *systematized the sequence of forms through an ideal cycle and provided a terminology.*" To this modest appraisal one may add that he was quick to see the excellencies and to praise the work of other men. We have mentioned his memoir of Gilbert. Equally appreciative is his biographical memoir of John Wesley Powell, whose life shows how a man of exceptional power may surmount "the limiting associations of early years, less through the opportunity provided by others than through opportunities opened by his own individual enterprise for the satisfaction of inborn interests." Davis enjoyed and often recalled the bluntness and vigor of the one-armed Civil War veteran, who first went down the Grand Canyon, directed the newly established Geological Survey, and wrote unpopular things about the "arid West" that we are now able properly to appraise through a generation of hard experience.

To Professor Davis is due the organization of the Association of American Geographers in 1904, at a meeting in his native Philadelphia. He immediately urged that the Association "publish or perish." "If it's worth doing it's worth printing," was his advice to students. He believed that one should be schooled to criticism early in his career as an offset to egotism, provincialism, lazy acceptance of one's self in a routine job. He hated the "stuffed shirt" of officialdom, whether in government or in scientific institutions. He was as quick to point out a modest man doing excellent work. Phrases meant nothing to him. Davis had contempt for the long-winded accounts about fleas and lice of the untrained traveler who is utterly unaware of the Stygian darkness of his mind with respect to topographic forms and their interpretation.

With great energy and intelligence he organized the Transcon-

tinental Excursion of 1912 under the auspices of the American Geographical Society, wrote a handbook of the United States for the members, urged the publication of a Memorial Volume on the Excursion, and brought European and American geographers into the most effective working relationship that they have ever enjoyed. He received the Cullum Geographical Medal of the Society in 1908, was exchange professor at Berlin in 1908–1909 and at Paris in 1911–1912, spoke frequently at international and national scientific meetings and congresses, conducted European excursions for students, encouraged the appointment of well-trained young physiographers to university faculties, advocated the expansion of programs of our geographical societies so as to make them scientific organizations and not merely "societies," and pressed on to the end with scarcely abated vigor and freshness of thought. The old challenge is there in "The Long Beach Earthquake" in the January number of the *Geographical Review* and in the essay published in the current number—remarkable papers for a man in his eighty-fourth year. His writings were germinant. He was a born teacher of scholars, forever sowing the seed. His students and friends will affectionately remember him for his unstinted devotion to their intellectual interests, his pride in their accomplishment, his never-ceasing zest for life, and for the stimulation of his creative spirit ever in search of new horizons.

ISAIAH BOWMAN

LAND PROBLEMS IN PUERTO RICO AND THE PHILIPPINE ISLANDS

Theodore Roosevelt

IN all agricultural countries the basic problem is land. The happiness of the people, the stability of the government, and the prosperity of all depend upon the manner in which the land holdings are treated.

In my own opinion the most satisfactory condition for a community of this sort is to have its land divided into reasonably small farms owned by individual farmers. Obviously this is not the method whereby the greatest efficiency can be attained, nor the greatest gross wealth for the nation. Large plantations owned by single individuals or companies and run by laborers are normally administered in a more efficient manner and can with greater ease avail themselves of market facilities, financing where necessary, and modern agricultural methods. On the other hand, the assets coming from small individual holdings more than offset this. Though the gross wealth may be greater where the land is divided into large holdings, the wealth of the average citizen in a community of small farms is greater. As a result, he has a greater stake in the community and is normally a more thoughtful and more contented individual. Furthermore, when a man owns his own farm there rests on his shoulders a responsibility that develops his ability and character.

A proper governmental department of agriculture can aid greatly the problems of these smaller farmers by disseminating through a carefully planned organization information on modern methods of cultivation, types of crops, fertilizers, and the like and by guiding the organization of coöperatives, the construction of warehouses, and other community undertakings.

In Puerto Rico and the Philippine Islands I approached the land problems from this standpoint.

Puerto Rico

Puerto Rico is a comparatively small island, about 100 miles long by 35 miles broad. Topographically it is a cluster of rugged hills bordered by a narrow coastal plain. There are numerous small streams but no navigable rivers. In the tropical climate crops can be grown at all seasons of the year, provided sufficient water is available. Mineral resources are of limited value as far as is known. The area is 3435 square miles, of which at least 10 per cent is unsuitable for cultivation. The population today is about 1,600,000, or more than 510 to the square mile of farm land. The rate of increase is rapid: it was 18.7 per cent in the decade from 1920 to 1930. The

problem is grave, for agriculture alone cannot support such a dense population at a reasonable standard of living. The matter is further complicated by the fact that while the northern half of the island has a regular and abundant rainfall the southern half has a scant and unevenly distributed amount and suffers from drought so that recourse must be had to irrigation. The heavy population has taken

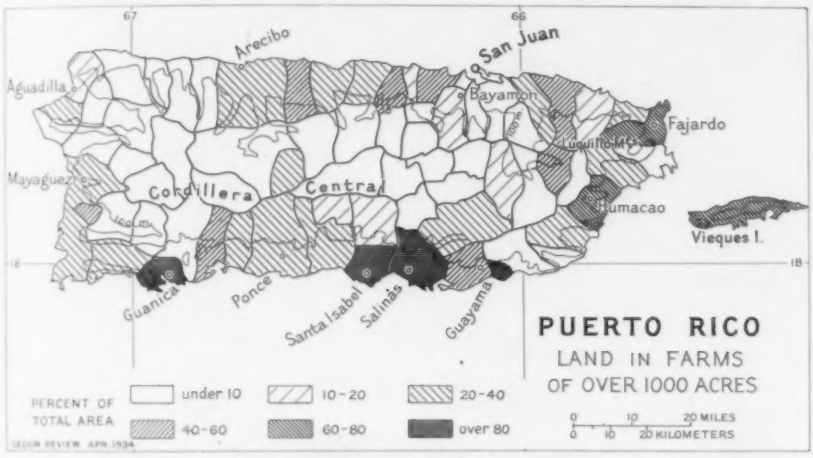

FIG. 1—The distribution of land in large farms in Puerto Rico by municipalities according to the census of 1930. Data are available only by administrative divisions that do not coincide with natural regions, and there is great variation in distribution within the municipalities; but the correspondence between the large farms and the coastal lowlands (the 100-meter contour line is shown) is clear even in this rough correlation. The irrigated plains of the south are especially important as sugar producers. The value of the cane crop (1929) for the municipalities of Guanica, Salinas, Humacao, and Fajardo alone was nearly four and a half million dollars, or more than one-fifth that for the entire island.

such a toll on the forests that they have been practically destroyed, with the coincident evils of flood and erosion. The entire island lies in the hurricane path of the West Indies and is desolated by these storms at frequent intervals.

Systems of Land Tenure

The island was settled by the Spaniards in the early sixteenth century. The inhabitants at that time consisted of a small number of indigenous Indians, who have disappeared during the past three hundred years, leaving scarcely a trace behind them. At the present moment the people are all descendants either of Spanish settlers or of negroes brought in for work on the plantations. The proportion of white to colored is roughly 3 to 1.

From the time of the first Spanish settlement the valuable lands of the coastal plain have been held in big haciendas. When the Americans arrived in 1898 the majority of the large landholders were bought out by sugar companies, in whose possession the properties remain today. The result is that the valuable lands in Puerto Rico

FIG. 2—Mosaic of aerial photographs of the vicinity of Central Coloso in northwestern Puerto Rico, south of Aguadilla. The Central is a little to the left of the center of the mosaic. Cane fields occupy the alluvial plain, *playa*, of the Rio Culebrinas. To the north is a limestone topography with typical development of haystack (*pepino*) hills. To the south is a thoroughly dissected shale country. To the east of the cane fields and south of the limestone escarpment is a rolling area used for cane and self-sufficing crops by the natives. (Photograph, taken by the U. S. Navy, property of the Insular Government.)

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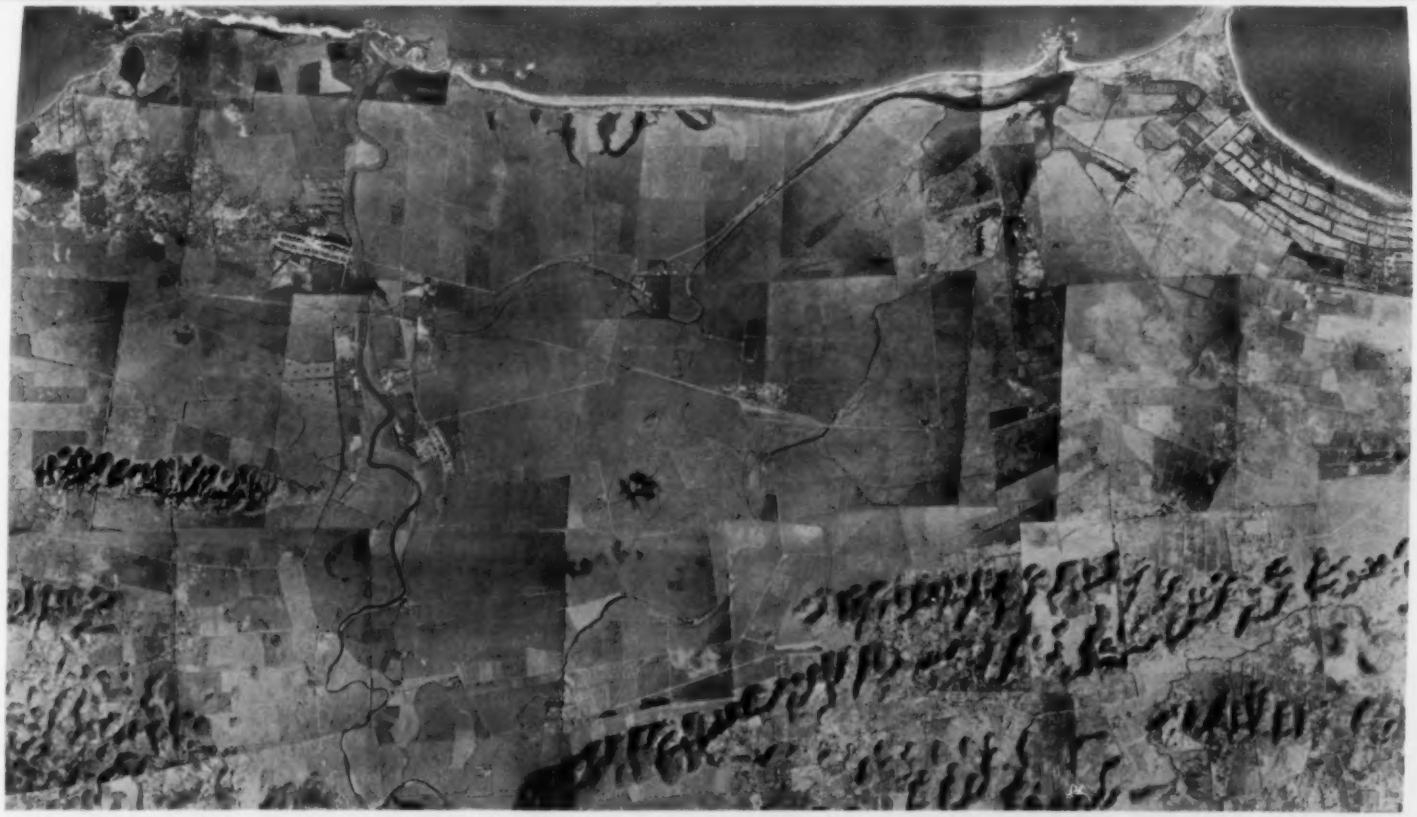

FIG. 3—Mosaic of aerial photographs covering a part of the northern coast of Puerto Rico west of San Juan. The Río Toa runs northward in the left half of the mosaic. West of the river and a short distance south of the coast is the city of Dorado; Toa Baja lies south of Dorado on the opposite side of the river. The smooth plain, limited on the south by the "bumpy" limestone belt, is all under cultivation. (Photograph, taken by the U. S. Navy, property of the Insular Government.)

are in the hands of a comparatively few individuals and corporations and that the great mass of the people are landless, serving as farm laborers on these big plantations or congregating in the cities, where there is little to do.

Practically all the small farm holdings that exist are in the poorer

FIG. 4—Arecibo harbor, looking northeast. Arecibo is the outlet for an important sugar-producing region on the northern coast of Puerto Rico. In the foreground are fields of cane. (Official photograph. U. S. Navy.)

lands of the interior, on the sides of the hills. The most profitable crop for the lowlands, thanks in large measure to the United States protective tariff, is sugar. An acre of land there has perhaps a 20 per cent greater value for the cultivation of cane than it has for any other crop, and cane does not lend itself profitably to cultivation on small farms.

There is in addition in the interior a widely spread system of tenant farming. The tenant farmers are divided into two classes, those who pay cash rent each year and those who farm on shares. The latter are known as *apaceros*, and custom in large measure dictates the arrangement between them and their landlords.

Because of the great density of the population practically all of the public lands had been disposed of by 1929. The government held only one block of any size, the Luquillo National Forest, which, clothing the high and broken mountain mass at the eastern end of the island, is needed for conservation purposes and practically useless for farming.

There was widespread discontent among the Puerto Ricans, for

the average agriculturist wanted his own farm, resenting bitterly the fact that he was landless and that those for whom he worked were absentee landlords, living in Europe, perhaps, or represented by stockholders in the United States.

The problem presented a number of aspects. In the first place,

FIG. 5—Guanica harbor, looking west. Guanica is an important sugar port on the southern coast of Puerto Rico. Sugar Central in the middle distance. (Official photograph, U. S. Navy.)

the government had no land to use for homesteading. In the second place, it could not possibly afford to buy land and turn it over to small farmers gratis. In the third place, even if free distribution of land were possible it would do no good unless the prospective tenants could raise enough thereon to give them a living and make it worth while for them to retain possession rather than to sell. These were the conditions of land distribution that the government had to meet.

THE HOMESTEAD COMMISSION

There was in existence a government organization called the Homestead Commission (Comisión de Hogares Seguros). This at its inception had disposed of a few small tracts of government land and had used the balance of its money for putting up workmen's settlements (*barrios obreros*) in the towns. It was decided that this organization could be usefully developed. Half a million dollars was raised through the sale of government bonds, and a policy was defined.

Evidently it would be foolish to buy the rich sugar lands, because after settling homesteaders thereon no crop could be found sufficiently

FIG. 6—Smooth limestone country lying south of the limestone escarpment and west of the Río Guajataca reservoir (40 kilometers from Quebradillas), used for irrigating sugar-cane land. Most of the land in the region of the photograph is used for subsistence crops—corn, beans and sweet potatoes. (Photograph, taken by the U. S. Navy, property of the Insular Government.)

profitable for a small farmer to prevent large holders from buying him out in the future. In other words, if the bottom lands were broken up today into small holdings, after the passage of a few years they would be again collected into large estates. Besides this, the money at hand was not sufficient to buy more than a very limited amount if used for the purchase of high-priced land.

METHODS OF THE COMMISSION

The Commission, therefore, turned its attention towards the lands in the interior, where they were cheaper and where many of the large owners were in financial difficulties and were glad to sell. Considerable purchases were made, totaling some 15,000 acres. No land was purchased except in large tracts. For instance, the estate El Duque,

FIG. 7

FIG. 8

FIG. 7—Contrasts in topography between smoother shale country, to the south, and "bumpy" limestone country to the north, in the Utuado region, northwestern Puerto Rico. (Photograph, taken by the U. S. Navy, property of the Insular Government.)

FIG. 8—Part of an area of intensive citrus cultivation a few miles southwest of San Juan. (Photograph, taken by the U. S. Navy, property of the Insular Government.)

whose owners resided in Europe, was bought for $30,000. There were 800 families living on it.

Once acquired, the land was divided into small holdings, the size based on fertility. Where the land was rich a four-acre farm was considered sufficiently large; on the rough hillsides 16 to 20 acres were allotted for each holding. The tenants were chosen with care, men of farming experience with families being given the preference.

Each tract of land was developed as a group (*colonia*). A trained government employee was retained as supervisor. As the government could not afford to give away the land, a system of payment was arranged on easy terms extending over a period of years, graduated in such fashion as to give the farm holders time to get on their feet. The government employee collected the rents. But this was

only a small part of his function. In addition he was charged with advising as to cultivation, suggesting crops, correcting methods, etc., and organizing a coöperative of a very simple sort for the sale of produce.

Because many of the poor people who took up these farms had never seen more than a few dollars in cash in their lives, it was decided that they must be guarded, at least for a time, against the temptation of selling their land. It is easy to see that a man who has never had more than five or ten dollars in cash, if offered three or four hundred dollars for his farm, would feel that he had great wealth within his grasp. He might well sell, go to town, spend the money in six months or a year, and again be a landless drifter. It was accordingly provided in the original contract that land could not be sold until full and final payment had been made and that no loans could be contracted thereon without the consent of the Commission.

We hoped that by our doing this the farmer would be in possession a sufficiently long time to have learned the value of his holding and to refuse to part with it.

This work had not been under way a sufficient length of time fully to have demonstrated its feasibility before I left Puerto Rico in 1932 for the Philippines. It was, however, progressing excellently. The collections for rents were good. There was delinquency of only 2 per cent, and this represented practically without exception mistakes made in the selection of an individual. In these instances, of course, the government always had the farm as security, and many other tenants were waiting to take the place of a man who because of drink or other failings was not making good. The Commission was kept out of politics, though it took a bitter and continuous battle to do so.

This Commission represented our direct and frontal attack. There were, however, other approaches, which had as their end the creation of conditions aiding small farmers to work their holdings profitably and, as a corollary, encouraged the acquisition of land irrespective of the Commission.

An Agricultural Extension Service

The question divided itself into two primary phases—what to cultivate and how to cultivate it, and then how to market the produce.

There was in Puerto Rico an excellent and efficient Department of Agriculture. That department, however, had bent its main efforts to the acquisition of knowledge through experimentation and study. We took as our thesis that the knowledge so acquired was only of value if it could be placed in the hands of those who could profit thereby. Accordingly we turned our endeavors towards developing an extension service.

Demonstration farms (*granjas agricolas*), operated by an employee of the Department of Agriculture, were scattered through the island in various zones. Each farm cultivated the crops most adaptable to its zone. The government employee who ran a farm was charged with the mission of getting as many of the surrounding farmers to visit him as was possible and was graded in direct ratio to the number of visitors he could report.

Agricultural agents (*agentes rurales*), generally trained men, were assigned to a specific zone. The schedules prepared for them comprised a series of visits: they were to go from place to place and advise with the farmers. Movable units (*unidades ambulantes*) amplified the scheme. Each consisted of a trained man with a Ford truck, in which were carried tools, fertilizers, plants, slips, etc. The units went from place to place, halting, collecting small farmers of the countryside, and making demonstrations of agricultural methods on some local farm. They worked on the theory that knowledge introduced through the eyes was more comprehensible and impressive than knowledge conveyed merely through the ears.

Another phase of the service was the creation, on farms, of secondary schools in which the children were instructed in the practical means of making a farm profitable and living conditions agreeable. The course comprised actual farming for the boys, home economics for the girls, and lectures and explanations for both on sanitation, basic hygiene, etc.

A determined attempt was made to encourage truck gardens for nome provisioning. This was done through both the Department of Agriculture and the schools. Many of the large sugar companies gave small garden plots to their workmen. One company had 1000 such plots, another 400. The Commissioner of Agriculture in 1931 reported that these gardens had increased by 30 to 40 per cent.

Bureau of Commerce and Industry

At the same time there was founded a Bureau of Commerce and Industry for the island, which had as an important part of its function the development of oversea markets for the agricultural produce, the establishment of local markets in the towns, and the arrangement of facilities for the shipment of produce so that it might reach its ultimate destination cheaply, expeditiously, and in good condition.

Though in my opinion tenant farming is not so good as small individual holdings owned in fee simple, still it is better than the farm-laborer system, with only periodic work and no premium on individual energy and initiative. We therefore studied the question of the *apacero* system and tried to improve it in such fashion as to protect the tenantry. In addition to the agricultural-extension work,

laws were passed providing for methods of accounting between tenants and landlords when payment was in kind and providing also that tenants could not be turned off property until after the harvest, even if no written agreement existed.

All these policies have as their ultimate objective the placing of Puerto Ricans on small farms of their own. However, even if successful they can only partly change present conditions, for they will merely establish small farmers in the interior lands or on such parts of the coastal plain as may not be suitable for sugar cultivation or farming on a large scale.

The Philippine Islands

When I went from Puerto Rico to the Philippine Islands I found there also a land problem, but one much less acute and lending itself far more easily to solution. The Philippines also are situated in the tropics, the group extending from latitude 4° 40′ N. to 21° 5′ N., a distance of 16° 25′ of latitude. There are, according to the Bureau of Coast and Geodetic Survey, 1095 islands sufficiently large and fertile to be inhabited. Of these, 11 have areas greater than 1000 square miles. The total land area of the Philippine Islands is 114,400 square miles, of which 95 per cent is in these 11 large islands, with 68 per cent in Luzon and Mindanao. There are rich alluvial plains, wooded or grass-covered mountains, rolling uplands, great swamp areas, tropical rain forests, and arid semideserts. The volcano, Mount Apo, in southern Mindanao, is the culminating peak of the islands, 9600 feet high. The big islands have large rivers, many of which are navigable. There is ample water power for development.

The Peoples

Ethnologically the Philippine Islands show a combination of different strains, amalgamated to a greater or lesser degree in the various localities. It is impossible to state definitely the exact elements that enter into the composition and when they arrived. I believe, however, that the following is approximately correct.

The original inhabitants before the land bridges to the continent went down were Negritos and Caucasian and Mongoloid pygmies. They have largely disappeared. The Negritos still exist in small numbers in the mountains and swamp lands of some of the Islands; the other two strains have merely left traces.

Following these came an immigration of proto-Malays. Then came four waves. The first was Indonesian. This type of tall, aquiline-featured people is represented by the Kalingas of northern Luzon. Then came an immigration of a different type of Indonesian, darker, shorter, and with small noses, typified by the Ilocanos. Next came

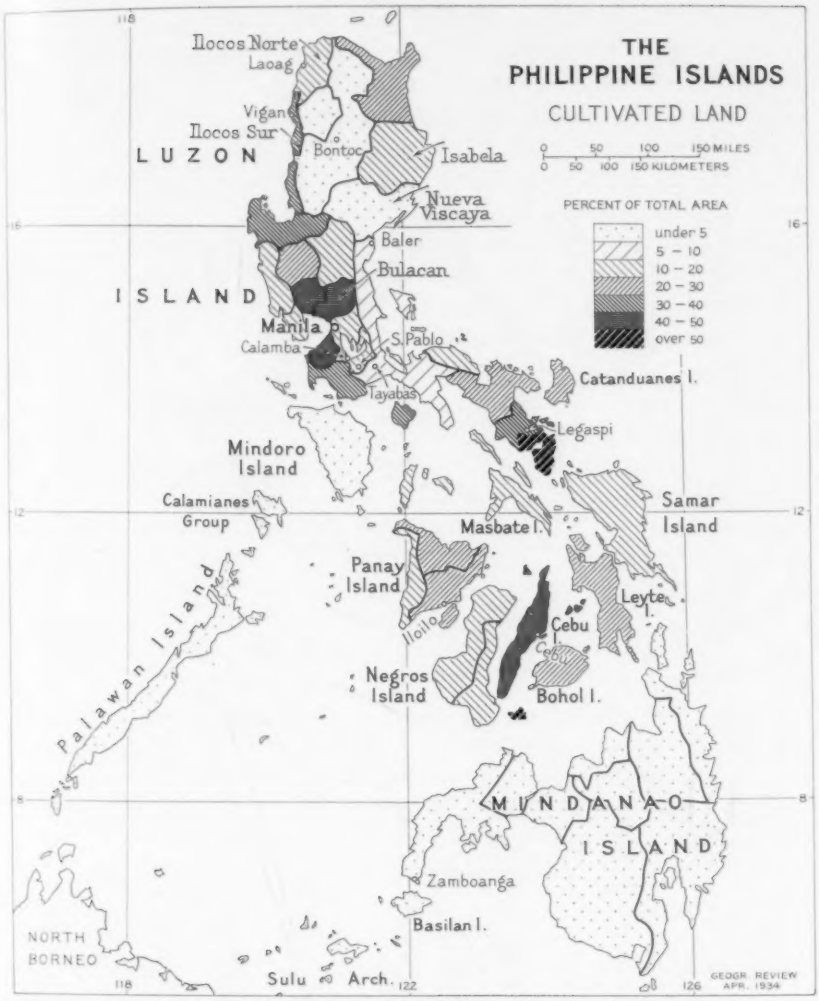

FIG. 9—The distribution of cultivated land in the Philippine Islands in 1924 according to figures from the Bureau of Forestry. In sum 12.5 per cent of the total land area of the Philippines was under cultivation, or not quite one-third of the total cultivable land.

two waves of Malays. All these latter migrations arrived in boats. The comparatively rapid amalgamation of races is measurably due to this, as the latter divisions brought few women with them and consequently bred with the people they found in the Islands.

The traces of this water-borne immigration are found in many of the local languages. As the immigrants came in boats, they penetrated the country by means of the rivers. In certain of the dialects the words for east and west, literally translated, are "up and down the river." Tagalog, the name of the people living in the district of which Manila is the center, means "the river folk." Sometimes we find the local word for village is "boatload."

There have been various other strains that came in small numbers at a later date. The Chinese chronicles mention trading in the tenth century with a point supposed to be in Mindoro. From then on there has been a more or less steady though limited influx of Chinese. In the fifteenth century for a brief period the Philippines were incorporated as a part of the Chinese Empire. A certain number of Japanese have also settled in the Islands. At the present moment the largest group is in the province of Davao in Mindanao.

The Spaniards, though they were rulers of the Philippines for some three hundred years, have left little of their blood in the people. The total number of Filipinos with American blood is practically negligible. Certain other strains, such as Arab and Hindu, are so slight that, like the American, they may be disregarded.

The big linguistic divisions today are three—Ilocano, Tagalog, and Viscayan. There are, however, 17 different dialects used by fairly large groups of people. Most of the languages have a Malay base and some words in common, but they are distinct, and a man who speaks one cannot for that reason understand the others. Filipino senators whose districts comprise, for example, parts of central Luzon may have to make their addresses in Tagalog, Ilocano, Pampangan, and Pangasinan. It is for this reason that the general knowledge of English is so important.

Today, because of the rise of the national spirit and the increase of communications, the unification of ethnological types is proceeding more rapidly than heretofore. No one who knows the Islands, however, would hesitate for a moment in distinguishing a Bicolano from an Ilocano.

The population is estimated to be a scant 14,000,000. There are, therefore, only about 120 people a square mile. Distribution, however, is very uneven. The province of Ilocos Sur in Luzon had nearly 600 to the square mile (according to an estimate of 1927); Nueva Viscaya, also in Luzon, had barely 11.

The Large Holdings

Before the Spaniards came to the Islands in the sixteenth century conditions were primitive. Local chieftains held sway over limited territories, and land tenure was generally on the tribal system. In many instances the entire territory in a given locality was held in the name of the headman, but for the use of the community.

After the Spaniards arrived this gradually changed. Various individuals acquired great tracts, as did certain companies, but the large holdings were those acquired by the Catholic Church. In 1898 the Recollects, Dominicans, and Augustinians owned 420,000 acres of choice land. Their great farms were run either with agricultural

laborers or on the tenant system. These great land holdings were a constant source of trouble and were unquestionably one of the causes of the various insurrections.

When the United States took over the Philippines the land question was one of the first problems confronting her. After a long series of conferences an agreement with the Church was reached in 1903. The Philippine government bought 410,000 acres at a cost of $7,239,000. After the purchase they were resold to the tenants at a fair appraisal value. The terms were payments of 8 per cent a year, one-half of which went to interest and one-half to amortization. By this method absolute title was acquired in 25 years. A portion of the land not taken up in this fashion was disposed of in large tracts.

Land Titles and Cadastral Survey

Another difficulty that confronted the small farmers of the Philippines was the question of their titles. The Spanish laws, though excellent in theory, had not been observed. There were supposed to be some 2,300,000 parcels of land privately owned, but titles were in such shape that the greater part of this property could not be sold, mortgaged, or used as collateral. As a result there were constant and costly litigations and individuals were dispossessed of property that they had cleared and that they believed to be theirs.

In order to right this a cadastral survey was initiated under Governor-General W. Cameron Forbes, and great progress was made. The plan adopted was the surveying of the municipal districts in rotation rather than the surveying of individual holdings. The matter was run by the insular government, with provisions, however, permitting under certain conditions provinces or even private corporations to undertake work for this purpose.

The cost of the cadastral survey was paid 10 per cent by the province, 10 per cent by the municipality, 10 per cent by the government, and 70 per cent by the owner. Under the so-called Torrens system a method was devised whereby title guaranteed by the government was provided after ownership was established and a survey made.

Government Land and Homestead Acts

Unlike Puerto Rico, the Philippine Islands had and still have a great quantity of government land of a most desirable character. In 1918 the census showed some 16,600,000 acres of public land suitable for agriculture. Early in the American administration a Bureau of Forestry and a Bureau of Public Lands had been organized: the former was charged with the conservation and care of the public forests, the latter with the guardianship and distribution of public lands. The former bureau, after a survey of a given area, advised the government

FIG. 10—A typical fishing village north of Manila. Fish traps are seen in the foreground; in the background are rice fields. (Official photograph, U. S. Army Air Corps.)

FIG. 11—San Pablo, Laguna Province, Luzon. The village is almost entirely surrounded by coconut groves. (Official photograph, U. S. Army Air Corps.)

FIG. 12—Bontoc, Mountain Province, Luzon. Rice paddies in the upper left on the mountain side. (Official photograph, U. S. Army Air Corps.)

FIG. 13—Calamba, Laguna Province, Luzon. Sugar-cane fields and rice paddies. (Official photograph, U. S. Army Air Corps.)

what property it felt must be kept for public forests. The balance was then available for homesteading.

The original Homestead Act prohibited allotments of more than 40 acres to individuals and limited the amount of land acquirable by a company to 2500 acres. These provisions were wise, as they prevented the exploitation of the public domain by large corporations, with the coincident social difficulties.

In 1924 the amount of land purchasable by an individual was raised to 360 acres. Statistics indicated that the average small farmer does not cultivate more than 10 acres, and it has been urged that even 40 acres are too large an allotment. I do not share this view, as I consider that the 40-acre tract gives him property on which he can settle his children.

During 25 years there had been approved 74,568 grants, totaling about 2,500,000 acres. The Director of Agriculture in 1927 estimated that there were then 1,500,000 families cultivating their own property. My observations lead me to believe this figure to be too high.

When I arrived in the Philippine Islands all these policies were in effect. The problem, however, had not by any means been settled.

Problems of the Land-Law Administration

There was a large number of small farm owners. The proportion, however, varied greatly in the provinces, as did the density of population. For example, in the Ilocos provinces, where there are a comparatively small amount of land and a large population, the average holding was something in the neighborhood of an acre and a half, which is far too small an amount to support an average family and, of course, implies a great many farms of much smaller size. In the Negros provinces, on the other hand, where sugar is the profitable crop, the land was held mainly in large blocks, and a high percentage of the people were landless. In Bulacan, where the crop is rice, there was a widespread tenant-farmer development.

The cadastral surveys, or rather their proving up, had fallen behind. The Bureau of Public Lands had got far ahead of the courts charged with hearing the cases. There were, in fact, some 200,000 unheard cases. Furthermore, because of the economic depression the cost of proving up titles had become so burdensome on the smaller man that he did not welcome but resented the surveys.

The homesteading policy was not organized in such a way as to reach those who wished to procure homesteads. Furthermore, numerous abuses had crept in. Land to be valuable for settlement purposes must have some degree of accessibility to the rest of the civilized community. This means roads. The insular government was building roads through parts of the public domain and throwing open to

settlers the lands on either side. Information as to where a road is going to be built naturally becomes public property quickly. Speculators in the large cities made a practice of taking up in large blocks all the desirable land on both sides of the projected road, hiring people to work on it to fulfill the minimum requirements and holding it for speculative purposes.

The government did not clear the titles on the public land for homesteading. When a homesteader had his claim approved by the government, it was stated specifically in the papers that the government did not guarantee the title. The result was two-fold: the would-be homesteader was often deterred from taking up land because he did not know whether he really had title, and many individuals cleared a homestead and worked on it for several years only to be dispossessed by some other claimant.

Because of the uncertainty as to the location of lands suitable for homesteads and as to what was or was not vacant, there was constant encroachment on the forestry reservation. Often, too, homesteaders unwittingly took up land on a tract belonging to some large landholder. The holder might be perfectly aware of this but, saying nothing, would let the little man clear and improve the property for a number of years and then turn him off without remedy.

There were some church lands that had not been bought and on which the old controversy was raging. These lands, indeed, furnished the focuses for an incipient communistic movement, fomented by agitators educated in Russia.

There was a tenantry problem also. Like Puerto Rico, the Philippine Islands had farming on shares (the *apacero* system). This varied greatly, according to the different provinces, different customs, and different types of landlords. In many instances it seemed to be working well. The tenants were happy and the farms well cultivated. In others there was bitter dissatisfaction.

The Usury Problem

Besides the difficulties enumerated above many sharp practices were common, all of which contributed to injustice and discontent. For example, where it was known that certain small farmers had not obtained full title to their land, some clever man would run his lines and advertise in the *Official Gazette* in accordance with the law. The little farmer either would be unaware that this had happened or would not know what to do about it. Time would pass, dispossession proceedings would be instituted, and the authorities, though convinced that injustice was being done, would be powerless to remedy it under the law.

Usury was rampant. Wealthy individuals were continually lend-

ing small farmers money at usurious rates, concealing the fact under a simple I. O. U. note or by some other method that rendered legal apprehension under existing laws almost impossible, bleeding their victims to the furthest limit, and finally expelling them and taking the land. A favorite method was the use of an old Spanish law that, in its essence, permitted the sale of the property in a manner similar

FIG. 14—Sugar-cane plantation on the South Road immediately south of Manila. (Official photograph, U. S. Army Air Corps.)

to the pledging of an article at a pawnbroker's. It was called the *pacto de retro*. Difficulties were increased by the fact that contracts of this sort were often made in English or Spanish—languages of which the little farmer was ignorant. Landlords also practiced usury in the form of advances to tenant farmers, sometimes in kind, sometimes in cash, both of which under existing laws could be handled in such fashion as to leave little chance of proving that usury had existed but such as kept the tenant practically in a state of slavery. To cite one only of numerous cases I investigated myself, there is that of a small farmer who borrowed 300 pesos ($150). He never obtained any more cash. When the time came to pay his interest each year, the usurer offered him remission if he would sign a document substituted for the original contract. This document was in a language he did not understand. At the end of four years he owed 3,000 pesos!

THE AGRICULTURAL PROBLEM

In addition to the problems of tenure there was the problem of agriculture—profitable crops, how to grow them and how to market

them. This problem was aggravated by the fact that in much of the rice district the old practice had been to grow one crop of rice, taking perhaps five months, and then, because there was not sufficient time to grow another crop, to let the land lie fallow the rest of the year. In a large part of the Philippines such modern practices as crop rotation, seed selection, etc. were entirely unknown. In addition, some

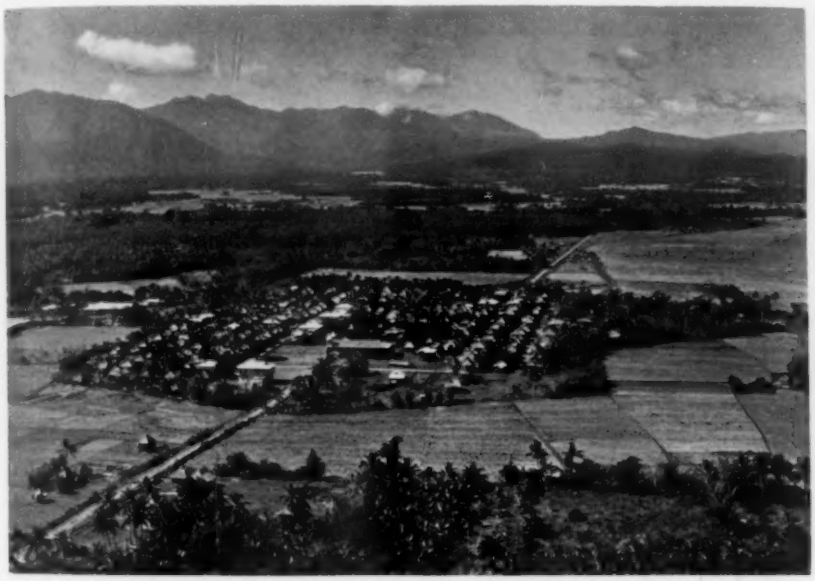

FIG. 15—Baler, Tayabas Province, Luzon; a typical Filipino village surrounded by coconut palms and sugar-cane fields. (Official photograph, U. S. Army Air Corps.)

of the basic crops, such as hemp (abacá), because of trade conditions, had become a surfeit on the market.

SPECIAL DIVISION FOR HOMESTEADS

To meet these conditions the administration adopted the following measures.

Further to facilitate homesteading, the entire problem of public lands was placed under a special undersecretary in the Department of Agriculture. A special division was created for homesteads. The mission of this section was, in the first instance, to aid and defend the homesteaders; in the second, to survey all the public lands to determine the precise amount available that was suitable for the purpose.

Eight of the best-adapted sites were set aside, beginning with a 25,000-acre tract in Isabela. Surveys were undertaken on these tracts, and they were divided into small plots of 40 to 60 acres each. The titles were cleared and guaranteed by the government. In con-

junction with the Department of Agriculture, the type of crops for which each locality was particularly adapted was determined. With the Bureau of Public Works, the plan for roads was decided upon.

The provincial governors, particularly in the congested provinces, were furnished with descriptions of the location of the homesteading tracts, as to how they could best be reached and to what cultivation they were adapted, and with instructions as to the filing of applications. The governors undertook to disseminate this information through the municipalities, the schools, and the local community assemblies, of which I shall speak later.

By executive order it was provided that for two kilometers on either side of any new road that might be opened through the public domain no tract of land of more than 350 acres could be taken up, that tracts of that size must be only sparingly granted, and that they could not have more than a limited frontage on the road. Under no circumstances were they to be contiguous. The reason for permitting a tract of even this size was that when homesteaders go to a new district they are very generally short of cash and it is helpful if somewhere within reach is a large farm on which they can obtain occasional employment to increase their cash capital.

Policy for Agricultural Schools

A new policy was evolved for the agricultural schools. This embodied in brief a change in the curriculum of the elementary agricultural schools that had as its objective the shortening of the period in school from four to two years. At the end of that time the class was moved to a special tract of government land. On it the pupils were to be granted homesteads of 40 acres each. An instructor lived among them, watching and directing their work. In this manner they would obtain the farms on which they were to live and while proving them up would gain their education. The policy was initiated by setting aside for this purpose a tract of 10,000 acres in the province of Leyte.

The Credit Problems

The question of usury was then taken up, for it is like pouring water into a bucket with a hole in it to establish small farmers on homesteads if conditions exist by which they are being continually dispossessed. This question clearly divides itself into two heads, the punishment of usurers and the provision of legitimate credit facilities, for the former is well-nigh useless without the latter.

To check the usurers a systematic campaign on the part of the insular government was undertaken. Cases were sought all through the Islands, prosecutions undertaken, and convictions obtained. Laws were recommended providing that contracts must be written in the

dialect of the locality. The charging of usurious interest was made a crime, not merely the collecting of it. License fees for money lenders were reduced.

Under a law previously passed the government bank started at once to found agricultural coöperative credit societies. These were not financed by the bank but were supervised by it. Ten were undertaken in different parts of the Islands. A law also gave permission for the establishment of special rural banks under the supervision of the government bank. Work on these was pushed.

A careful investigation was made of the tenant-landlord relationship and a law passed thereon. This law provided for written contracts in the dialect, prohibited advances by the landlord to the tenant at exorbitant rates and required that advances should be witnessed and established by documents in the dialect, provided an annual accounting, and required a division of produce immediately after the harvest.

Even this is only partly satisfactory, as there are many vexatious questions untouched. For example, if a work animal is provided by the landlord or tenant, what credit shall be allowed for it? Again, to what warehouse and at whose expense shall the produce due the landlord be transported? And shall subsidiary crops, such as vegetables raised primarily for the tenant's family, be subject to any division with the landlord? The start has been made, however, and I believe that ensuing years will see this law extended, changed, and made more effective.

Next comes the general question of agriculture. Here the problem was broadly similar to that in Puerto Rico, namely the dissemination of necessary knowledge to farmers in general, but particularly to the small farmer.

Community Assemblies

There was in the school system in the Islands an excellent policy embodying instruction in truck gardening. This culminated in a Garden Day held in the several localities, when pupils exhibited their produce and when the parents attended. These were in fact miniature fairs. A system was set under way to extend and amplify this, providing for annual provincial fairs in which the various schools participated. Finally came the carnival held at Manila, which has become as years have passed more a fair than a carnival.

A plan for movable units identical with those in Puerto Rico was adopted, and the insular government agreed to coöperate to the fullest extent with the provinces in their fairs.

Community assemblies were started. These were based directly on the school system and a schedule was set on foot to provide eventually for one every month in each municipality or distant *barrio*.

Their function is to supply to the people by lecture, demonstration, and the like, information on subjects vital to their interest. A large part naturally has to do with agricultural development. Under the advice of the Department of Agriculture a course of lectures was developed comprising such subjects as crop rotation, fertilization, seed selection, plant diseases, animal husbandry, etc. Lectures also dealt with usury, the rights of citizens under the land laws, homesteading, and all the kindred problems.

A law was passed permitting the construction, under regulations, of municipal warehouses. Regulations for the development and coördination of local markets were undertaken. Finally, through a carefully considered tariff, produce now imported from other countries and capable of being produced on the Islands was given protection.

This work that I have outlined is, I understand, being amplified, continued, and developed under the present governor-general.

To sum up, in both Puerto Rico and the Philippine Islands the problem is to give the average man in the community a chance to get a farm of his own. It was to this end that governmental policies were shaped. A beginning has been made, but that is all. In the former country the difficulties are much greater; indeed, some seem almost insurmountable. In the latter, however, there is no reason why carefully considered, energetically administered governmental policies should not eventually bring a happy solution.

THE MICHIGAN–PAN AMERICAN AIRWAYS GREENLAND EXPEDITION

PRELIMINARY RESULTS

R. L. Belknap
University of Michigan

THE University of Michigan–Pan American Airways Greenland Expedition was organized in the spring of 1932 to make certain glaciological investigations and to take part in the Second International Polar Year program. We established our base station on the Upper Nugssuak near the Cornell Glacier in the Upernivik district on the west coast of Greenland (Fig. 1), at about latitude 74° 19′ N. and longitude 56° 08′ W. We planned to carry out the meteorological program of the International Polar Year and also some of the auroral observations. Since we were located in a not too well known part of Greenland, we made some additions to the existing maps, resurveyed Cornell Glacier, which had been mapped in 1896 by R. S. Tarr, made the first systematic botanical collection from this area, and conducted special investigations in connection with the study of glaciation. We ran an auxiliary weather station for comparative purposes at the village of Kraulshavn, 30 miles west of our base, and another on the inland ice, about 180 miles in from the front of the ice.

Narrative of the Expedition

Evans Schmeling, aerologist and assistant director of the expedition, with Herbert Gardner, photographer and botanist, were landed at the site selected for the base and were ready to begin work August 1, the beginning of the Polar Year. In September we built our winter quarters, Peary Lodge, and received our remaining supplies, brought up by Max Demorest, assistant geologist, and Karl V. Hansen, radio operator, from Copenhagen.

The month of October was spent in making final preparations for winter and in setting and locating a series of stakes across Cornell Glacier for determination of the ice movement during the winter season. The sea ice forming during November and the first half of December prevented travel by boat, yet was not sufficiently strong to allow safe sledging. During this time, when we were confined to the area in the immediate vicinity of our camp, we were busy with the auroral and meteorological work and with preparations for late-winter and spring activities.

In January we obtained our first dog team, the care of which fell upon Schmeling. With this Greenland dog team, trained to travel

FIG. 1—Map showing the stations and routes of the Michigan-Pan American Airways Greenland Expedition of 1932-1933. Peary Lodge was the base station. An auxiliary meteorological station was at Kraulshavn. The inset shows the ice-cap station, Camp Watkins, with the sites of Wegener's "Eismitte" station and the British Arctic Air Route Expedition's inland ice station shown for comparison of locations. Scale of the main map 1 : 1,900,000.

rapidly, pulling rather lightly loaded sledges, we could travel about, covering on occasion 90 miles in a single day. Considerable time was spent in the late winter in exploring the territory north and south of our camp in an attempt to find the most feasible place from which we could start over the badly crevassed margin of the inland ice. At the same time, using stars instead of the sun, we determined the latitude and longitude of three triangulation stations.

In March Schmeling and I made a sledge trip southward to Upernivik and Pröven, partly for geological study, partly to obtain a supply of dried shark meat for use as dog food on the inland ice. On this trip we covered about 450 miles, averaging about 65 miles a day in actual sledging time.

During the month of April we transferred our self-recording instruments to Kraulshavn, set up a "homemade" tide gauge, and took hourly readings, during the entire twenty-four hours, of all meteorological instruments as well as of the height of the tide.

With a Greenlander as a guide, Schmeling and I made our last long sledge trip over the sea ice in May. We went northward from camp past Devil's Thumb to Karusulik, the northernmost village of the Upernivik district. Again we examined the edge of the inland ice and found one comparatively smooth place north of Wandel Land, too inaccessible, however, for our use. In addition, we remapped part of the area along the edge of the inland ice that comes practically out to the sea from Wandel Land northward to Cape York. We returned from the trip after an absence of one week to find the sea ice flooded or rapidly breaking up and the snow, which had been between two and three feet thick when we left, almost entirely gone. Winter had passed; it was now summer!

On June 13 Schmeling, Demorest, and I left camp to start our inland-ice work. The meteorological work at Peary Lodge was divided between Hansen and Gardner, both of whom had received special training during the winter to enable them to run the station during our absence.

Our start over the inland ice was actually made on June 17, the intervening days being taken up by land portages and in crossing two fiords where the sea ice was in poor condition. The winter's accumulation of snow on the inland ice was just beginning to melt. By carefully picking our way we avoided the rougher part of the ice and the bigger crevasses, the smaller ones being bridged by snow that as a general rule proved strong enough to support our dogs and heavily loaded sledges. Keeping as near as possible to the divide between the basins of the Cornell and Igdlulik glaciers, we made our way up over a series of terraces, running levels as we went. At the end of two weeks, however, there had been several days lost owing to blizzards, and we had never been able to make more than fifteen miles a

day; so we were only some sixty miles east of our starting point and at an elevation of about six thousand feet. To save time and food, we decided to discontinue leveling and to push ahead as rapidly as possible. Happily several days of fine weather enabled us to average about thirty miles a day, and the sledges glided so easily over the firm surface that all three of us rode instead of going forward on skis.

FIG. 2—View across the valley in which the base camp, Peary Lodge (lower left-hand corner) was situated.

Our summer station, named Camp Watkins in honor of the memory of the English explorer, was established at an elevation of 8840 feet about 75 miles west of the continental divide as located by Koch and Wegener in 1913. From our astronomical observations this camp was at latitude 74° 40′ N. and longitude 47° 29′ W. The meteorological observations of temperature, pressure, wind direction and velocity, precipitation, and cloud movement were begun at 8 a. m., July 2, and continued until 8 a. m., August 19.

Schmeling and Demorest left Camp Watkins July 3 and reached Peary Lodge, our base camp, in five days, an average of about 40 miles a day for the return trip. They started for Camp Watkins the second time on August 6, under much worse traveling conditions, and were so delayed by storms and loss of dogs that we were unable to return to our base until September 10. A few days later we packed our equipment, closed the station, and were homeward bound.

It will take some time to assemble and organize the data collected. We are able at this time to present briefly a few observations that will give an idea of the nature of the results we are finding. This must be prefaced by a brief discussion of the general character of the area.

THE NUGSSUAK AREA

For government purposes Danish West Greenland is divided into a number of districts, the boundaries of which are arbitrarily determined but in some instances follow a topographic feature such as a fiord or river valley. These districts are in turn subdivided into small divisions called *udsteds*. In each udsted there is a centrally located community in which there is a small store, or *botiken*—a place where

the Greenlanders sell furs, ivory, and seal fat and buy such necessities as cloth, a limited supply of foods, and ammunition and guns and incidentals such as toys and tobacco. There may be any number of smaller communities or living places, *boplads*, in the udsted around the central or main settlement.

Our camp was located in the northernmost, or Kraulshavn, udsted in the Upernivik district.

FIG. 3—Surveying the coast near Devil's Thumb.

Nugssuak, or more properly Upper Nugssuak, to distinguish it from another larger peninsula opposite Disko Island, is the largest and most important land mass in the Kraulshavn udsted. This peninsula extends 35 miles southwestward from the edge of the inland ice as a narrow ridge sometimes rising to an elevation of 3000 feet but frequently cut by transverse valleys, one of which has been eroded almost to sea level. The present bare, mountainous, boulder-strewn landscape has been molded primarily by, and as a result of, glaciation, modified slightly by wave action.

The nine settlements, or living places, in the Kraulshavn udsted have been established during the last two decades. Kraulshavn, one of the more recent ones, is located near the western end of Nugssuak—a location selected because of the good harbor, accessible from the open sea from July until November, and the central location with respect to the other settlements. Of course most of the traveling is done by dog sledge. Since Ryder's Ice Fiord, on the south of Nugssuak, contains a large amount of glacial ice, it freezes over early in December and remains frozen till late June or early July. Hence it is only from the time the sea ice becomes dangerous for kayaking in September until sledging is feasible in December that the Greenlanders are shut off from Kraulshavn and its supplies.

Kraulshavn is a pioneer district in the sense that it is newly occupied by Eskimos, who have migrated thither because of the

scarcity of game and fish farther south. Permanent living places have been founded at points offering harbor protection from the more severe storms, suitable exposure to the sun, and easy access to good hunting grounds, for the inhabitants derive their living entirely from hunting. In practically all cases the new settlement is located

FIG. 4—View southeast from Peary Lodge across the lake and Ryder's Ice Fiord showing badly crevassed ice of the south branch of Cornell Glacier.

on or near the site of an old one, the inhabitants of which died off or migrated perhaps over a century ago and which dates, it may be, from the time of the first southward migration of the Eskimos.[1] As the population of the new settlement increases, the game becomes scarcer. Moreover, all the game—principally seal, with a few polar bear, Greenland whale, and fox—is of a migratory nature. As a result the people are somewhat nomadic, and the population of the various settlements fluctuates to such an extent that a census, in the ordinary sense, is of little significance.

Peary Lodge was located on a ridge in one of the valleys crossing Nugssuak near its inner, or eastern, end. We selected a site that was twelve miles from the closest settlement yet was on a sledging route frequently used by the Greenlanders.

THE BOTANICAL COLLECTION

The area has been described as being quite barren. Practically the only soil is that derived from the deposits of the glacier when it

[1] Cf. Therkel Mathiassen: An Old Eskimo Culture in West Greenland: Report of an Archeological Expedition to Upernivik, *Geogr. Rev.*, Vol. 20, 1930, pp. 605–614; *idem:* Inugsuk, a Mediaeval Eskimo Settlement in Upernivik District, West Greenland, *Meddelelser om Grønland*, Vol. 77, 1931, pp. 145–340.

was retreating eastward and is to be found on the flatter slopes and valley bottoms, and here is all the meager vegetation—mostly grasses and shrubs. The vegetation, however, plays a very minor rôle in the life of the Greenlander. It is true that in selecting a site for a new village consideration must be given to the questions whether there is

FIG. 5.—High land holding back the inland ice between Cornell and Ussing glaciers. The lower edge of the débris-covered tongue is 1500 feet above sea level.

sod available for use in building the walls of the house and whether there is peat suitable for fuel during the summer months. There are 75 different species of plants in our collection. As far as is now known, it presents no features of unusual interest.

TOPOGRAPHY AND ROCKS

On the March sledge trip to Pröven and the May trip to Karusulik considerable attention was given to the geology of the district. Though much of the land was deeply buried in snow, we were able to examine the sea cliffs or precipitous slopes rising from shore lines that are accessible from the sea ice only during the winter.

At the southern boundary of the Upernivik district the topography is characterized by the relatively high, flat-topped plateaus—land forms resulting from the massive lava flows that cover the underlying gneisses and schists with a basalt capping. About Pröven the formation changes, affording, it has been observed,[2] "a good guide when making Pröven from the sea."

[2] T. V. Garde: The Navigation of Greenland, *in* Greenland, Vol. 3, The Colonization of Greenland and Its History until 1929, published by the Commission for the Direction of the Geological and Geographical Investigations in Greenland, Copenhagen and London, 1929, pp. 215–241; reference on p. 240.

pp. 145–340.

FIG. 6—Névé and glaciers on the north side of Upper Nugssuak.

North of the basalt area the structure is quite complex but may for our purposes be considered as consisting of metamorphic masses in which has been developed a schistose structure with strata as definite as are found in sedimentary rock. The strata usually rise from an easterly direction to westward or southwestward in a series of peninsulas or islands such as Nugssuak and Holm Island. They are probably the eroded remnants of folds, the erosion having been controlled by fractures.

The predominant rock is a rather acid, light-colored gneiss, easily distinguished by the reddish hue upon its weathered surface, except where blackened by a covering of lichens. Next in importance is a darker-colored schistose rock almost basaltic in appearance found as an intrusive in the gneiss. A series of less basic dikes is probably of the same age—pre-Cambrian. Of more recent origin is a series of extremely acid pegmatite dikes. In summary we can say that in its lithologic aspect the area has a striking similarity to the Canadian Shield.

At one locality on the northern side of Holm Island and at another on Devil's Thumb (Fig. 3), opposite Holm Island, there occur three other types of rock. The principal one is a fine-grained diorite occurring as small intrusions with radial dikes extending out from the main intrusive and changing gradually into a fine-grained basalt. The well known landmark of the Devil's Thumb consists of a huge, narrow shaft or neck rising about 750 feet above the rest of the island to an elevation of over 2600 feet. The rock of which this neck is composed appears somewhat metamorphosed and may be called an augen-gneiss. The main mass is cut by small pegmatitic dikes and also contains basic inclusions. The Devil's Thumb intrusive is definitely younger than the country rock, which is the same acid gneiss common elsewhere, and no definite relationship could be found between it and the dioritic intrusives near-by. However, we believe our field data will show that the dioritic masses represent the most recent rock-forming activity in the district, perhaps having taken place even as late as Tertiary time.

on p. 240.

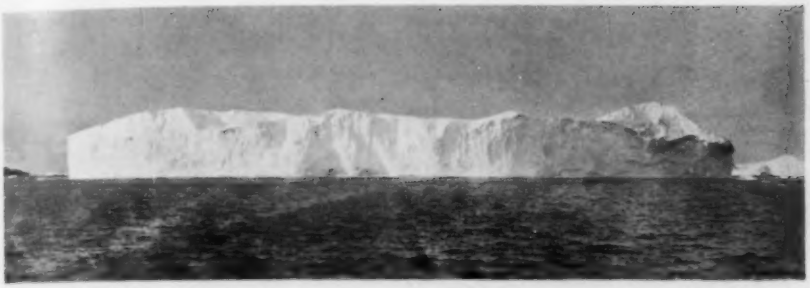

FIG. 7—A tabular berg in Ryder's Ice Fiord near Cornell Glacier. Approximate dimensions 1600 by 300 feet and 60 feet above water level.

PAST GLACIATION

There is no doubt that the ice once extended seaward over the entire land mass. Evidence of continental glaciation is found even on the outermost islands—Duck Islands—opposite the end of Nugssuak. Erosion by the ice moving from the east and controlled by the structure has given this mountainous area a rather smooth appearance when viewed from the east. Most of the land elements, however, end abruptly in steep slopes or cliffs on the seaward side—again an effect produced by glaciation and now maintained by the sapping action of the ice foot and waves. As seen from the sea then, the land in general presents a very rugged appearance.

The occurrence of partially erased cirques leads to the belief that mountain glaciers were active before the time when the ice cap covered the entire area. Aside from these, the sharp alpine effects produced by the earlier mountain glaciation were removed by the ice cap, which left a much smoother, more subdued type of topography as it receded. Since the recession of the continental ice, however, local glaciers and névés have been active again, and as a result Nugssuak and Holm Island in particular have a more rugged type of topography. This action is much more effective on the northern than on the southern slopes. Tarr[3] has described these glaciers and névés as remnants of the former ice sheet. As a result of our own studies this is not believed to be true in all cases.

While there are a relatively large number of lakes either rock-basin or ice-dammed, none are morainal. There has, in fact, been but little deposition by the continental glacier. Erratics are of common occurrence, scattered widely over the entire area. Along the shore of Ryder's Ice Fiord there are a few moraines made up mostly of boulders but in a few places composed of a very fine silt. We were able also to trace a boulder belt paralleling the present ice front and about a mile west of it across the peninsula from this fiord to that north of Igdlulik.

[3] R. S. Tarr: Valley Glaciers of the Upper Nugsuak Peninsula, Greenland, *Amer. Geologist*, Vol. 19, 1897, pp. 262–267.

Soundings from the sea ice of the Ice Fiord revealed a much greater depth of water on the north side of the fiord, because the more active south arm of the glacier has deposited much more material along the south side of the fiord.

FIG. 8—Moraine along valley wall and depression between valley wall and northern edge of Cornell Glacier. Note débris deposited on top of the ice where a stream following the depression empties into the fiord—a miniature "pitted" plain.

PRESENT CONDITION OF GLACIERS

The Cornell party under the direction of R. S. Tarr made a special study of the Cornell Glacier during the summer of 1896. There has been so little change since then that Tarr's[4] description gives a fairly accurate picture of present-day conditions. Rather than repeat the description, we shall give some additional information here and later compare in detail our results with those of the Cornell expedition.

Of outstanding importance is the fact that, unlike most of the Greenland coast, the inland ice actually extends out to the seaboard from Upernivik northward to beyond Cape York—a condition somewhat comparable to that along the coast of Antarctica. As a result, the quantity of bergs and glacial ice along the shore is greater here than farther south. Furthermore, most of the icebergs from this section are of the flat, tabular type rather than of the irregular type considered as characteristic of the North Atlantic. They seem to differ from the Antarctic type only in that they are smaller and of greater density.

From the progress so far made on our own maps in comparison

[4] The Margin of the Cornell Glacier, *Amer. Geologist*, Vol. 20, 1897, pp. 139–156.

with the older maps of the area there seems to be no doubt that a considerable recession of the ice has taken place. Minor fluctuations also are described by the Greenlanders. These may be accounted for in various ways—by a decrease in the amount of precipitation or an

FIG. 9—Snow cornice and shallow bergschrund (?) formed along the upper edge of a hanging glacier on the northern side of Upper Nugssuak.

increase in the average annual temperature or by the fact that over a period of several years the sea ice may be so weak and present for such a short season that it does not interfere with the discharge from the edge of the inland ice.

At present it is impossible to determine which of these has been the cause of the last recession. We do know that the Cornell Glacier was almost motionless during the winter season. This is partly to be explained by the formation of thick, heavy sea ice that, pinched between the sides of the fiord, acts as a dam to further movement. It is also apparent that temperature changes, especially increases, play an important rôle in glacier movement.

The marginal, crevassed zone of the ice is less than 50 miles wide opposite the Cornell outlet. We made the ascent over a relatively flat slope from a point midway between the Cornell and Igdlulik glaciers. By following the divide between the two basins we avoided the worst of the crevasses. However, even along that course the ice is far from stagnant. Most of the winter snow was still on the surface in the middle of June. We crossed a series of ridges or terraces, steep on the west side but flat or with a very slight back slope on the east. At the end of the first 25 miles the surface was still undulating, but no crevasses were apparent; two weeks later, however, much of the

snow had melted, revealing a veritable maze of crevasses. In early September crevasses were encountered at a distance of about 40 miles from the edge of the ice. Eastward from that point some snow remained on top of the ice; westward the surface exposed was of ice, except where the depressions were beginning to fill with the freshly fallen snow, the beginning of another winter's accumulation.

In the latitude of Peary Lodge there is a shrinkage in the marginal zone of the inland ice. That is, ablation is greatly in excess of precipitation. Not only does the winter's accumulation of snow disappear during the summer but part of the underlying ice also. This condition holds true for a zone at least 40 miles wide. No evaporation measurements were made but inasmuch as there was an accumulation of over 14 inches of snow at Camp Watkins during the 7 weeks that that station was occupied, there can be little doubt that the precipitation is far in excess of the snow waste in this central area.

The profile from our levels will be presented later. Now it is sufficient to say that from a point about 55 miles inland the slopes become more and more imperceptible till it was only by using the level that we could determine the slope at all. In the last 25 miles the rise was less than 250 feet.

Meteorological Observations

Daily and monthly averages of the meteorological data are not yet available, so it is impossible to give definite values, but we can describe the year's weather in general terms.

September and October were characterized by fairly clear weather with a gradually decreasing temperature, low average pressure, and practically no northerly winds. The temperature continued to decrease slowly till the middle of February, but with a slight increase in precipitation and in average pressure. The most severe storm of the year occurred in February. During this storm the temperature rose from −32° F. to + 47° in about 48 hours, the pressure dropped to approximately 28 inches, and the wind reached a maximum velocity of over 100 miles per hour. The storm ended with a fall of about 3 feet of snow. From this time until late May or June the weather was remarkably good—clear, cold, very little precipitation, and, unlike the autumn and early winter, the wind came part of the time from a northerly direction. The minimum temperature of this period came shortly after the first of March and was followed by gradually increasing temperature and high atmospheric pressure. In late May the snow disappeared suddenly—a rapid change to summer weather in June, July, and August. The summer weather was characterized by fog and heavy precipitation. During the entire year there were not more than 15 storms with gust wind velocities of over 50 miles an hour.

This is relatively low and in direct contrast with conditions found in other parts of Greenland, especially on the east coast.

The regular ground observations of a meteorological station were maintained at Peary Lodge for a period of one year. These included the recording of temperatures; of air pressure; of relative humidity, visibility, state of sky, and amount and character of precipitation. Hourly values of air pressure, air temperature, wind direction, and wind velocity were obtained by the use of self-recording instruments.

In addition, 60 pilot-balloon ascensions were made. Fog, low clouds, and precipitation, combined with the dark winter period, were instrumental in cutting down the amount of upper-air work. During the winter local fogs due to the presence of near-by open water often reduced surface visibility to the point where balloon work was impossible. Summer concentration of precipitation—48 per cent of our total precipitation of 18.42 inches was recorded in July and August—was also a hindrance.

Auxiliary weather stations were maintained at Kraulshavn for the month of April and at Camp Watkins on the inland ice for the month of July and most of August.

A study of the Peary Lodge statistics shows that the surface winds are predominantly from south to southeast. The aerological work indicates that these winds persist to an elevation of about 2500 meters, above which there is a shift into the western quadrant. This reversal of direction is characteristic of the air circulation of West Greenland.

The highest temperature recorded was 62° F., in July, and the lowest −36° F., in March. Only four months of the year have an average temperature above freezing, although heavy frosts do occur during this period of June through September. The average temperature for the year was about 14° F.

During the time the auxiliary station at Kraulshavn was maintained two severe storms with strong winds from the southeast were experienced at Peary Lodge. It is interesting to note that practically normal conditions existed at Kraulshavn at the time. This is in agreement with past observations of the University of Michigan expeditions that the strong winds from the ice cap are dominant only a short distance seaward; thence coastwise winds prevail.

The modifying effect of the inland ice can be seen in an examination of temperature ranges. The average temperature range at Kraulshavn was 30° F., while that at Peary Lodge was 18° F.; the average temperature at Kraulshavn was considerably higher than that of Peary Lodge.

At Camp Watkins light but steady winds were observed. These were from the south-southeast 24 per cent of the time, with an average

velocity of 11.6 miles an hour; south-southwest 19 per cent and 9.4 miles an hour; and southwest 12 per cent and 13 miles an hour. The other directions were mainly from the southern quadrant (south and southeast 11 per cent each). The average velocity of all winds was 11.7 miles an hour, and it is noteworthy that all average velocities ranged between the narrow limits of 5 and 15 miles an hour. The highest observed velocity was 35 miles an hour, and only 5 hours of calm were recorded.

The close connection between the daily temperature range and the length of the day can be seen in the Camp Watkins observations. Continuous daylight was experienced up to August 12. The average daily temperature range was 9° F. for July and 22° F. for August. The highest temperature recorded was 29° F., on July 20, and the lowest was −20° F., on August 4. The average temperature for July was 14° F. and for August 7° F.

The average state of the sky was partly cloudy at all three stations. There is one noteworthy difference in that the high-level cloud forms were more frequent at Camp Watkins. Alto-stratus was present a good deal of the time at Peary Lodge, and this intermediate type undoubtedly cut off a view of the cirrus forms above, thus causing fewer observations of them.

THE MUSEUM OF REGIONAL GEOGRAPHY IN LEIPZIG

Rudolf Reinhard
Museum für Landerkunde zu Leipzig

GEOGRAPHY, as compared with other sciences, has been curiously backward in utilizing museums as an educational tool and a medium of popularization. This is all the more surprising because geography, more than other sciences, is dependent on the use of visual methods. The mediums for geographical visualization, such as maps, relief models, photographs, diagrams, working models, etc., are, as Hettner has pointed out, not only aids in oral and written presentation but descriptive material in themselves, of equal importance with textual description and representing independent judgments and juxtapositions of facts. The importance of visual material has indeed been fully recognized by modern geography, as witnesses the development of collections of university and school departments of geography. Space does not permit the discussion here of the question why, nevertheless, geographical museums have heretofore been rare phenomena—as far as known, Leipzig and Leningrad are the only places in which such museums exist.[1]

But a need for geographical museums has always been felt, and thirty years ago J. G. Bartholomew outlined a comprehensive plan for such a museum but though the proposal led to animated discussion the plan was not realized.[2] It was the scientist and explorer, Alphons Stübel, of Leipzig, who first took concrete steps toward the establishment of a geographical museum. In 1896 he presented his extensive volcanological collection to the city of Leipzig with the provision that it should be expanded into a "Museum of Comparative Regional Geography." The volcanological section of this museum, which was arranged by Stübel himself, is well known to specialists in that field. After his death in 1904, however, no further expansion of the museum took place until nearly a quarter of a century later, when a professional geographer became the director of the Museum. The promising development that has taken place since 1927 was curtailed in 1931 by the economic depression, so that for the time being further expansion has had to be postponed.

[1] Benjamin Semenov-Tian-Shansky: The Geographical Museum, *Geogr. Rev.*, Vol. 19, 1929, pp. 642–648; and the papers by the writer, "Grundsätzliches zur Frage geographischer Museen, erörtert am Beispiele des Museums für Länderkunde zu Leipzig," *Wiss. Veröffentl. des Museums für Länderkunde zu Leipzig*, No. 1 (N.S.), 1932, pp. 3–20, and "Das geographische Museum: Ein neuer Museumstyp," *Museumskunde*, No. 3 (N.S.), Berlin, 1933.

[2] J. G. Bartholomew: A Plea for a National Institute of Geography, *Scottish Geogr. Mag.*, Vol. 18, 1902, pp. 144–148. Also Patrick Geddes, "Note on Draft Plan for Institute of Geography," *ibid.*, pp. 142–144, and the letters, *ibid.*, pp. 217–220. Professor Geddes developed a "Civic Observatory and Laboratory" in the Outlook Tower in Edinburgh ("Cities in Evolution," London, 1915, pp. 321–327).

The retardation brought about by these conditions offers an appropriate opportunity to report on the work done so far and to discuss the viewpoints and principles on which it has been based.

The content and subdivision of the Museum of Regional Geography in Leipzig (Museum für Länderkunde zu Leipzig), as contemplated in the comprehensive plan, are based on the content and classification of geography[3]. The Museum, therefore, has two aspects, one dealing with regional geography and the other with general geography. The material relating to regional geography is most conveniently arranged according to the customary subdivision of the earth into seven continents, even though from a scientific viewpoint valid objections may be brought against this subdivision.

It is a more or less open question how the individual continents should be subdivided. Either a continent may be considered as a unit under each heading of general geography and the individual regions be subdivided and classified according to these headings or a continent may be divided into regions and each region be independently portrayed in all its aspects. In the first case the divisional principle would be dynamic; in the second case, regional and static. But these are questions that do not only concern museum arrangement but call for solution in the case of every major piece of geographical research. These questions have been amply discussed in recent years in methodological publications, so that there is no need to go into them here. Moreover, a museum cannot decide these problems according to either the purely scientific or the educational viewpoint. It must take practical considerations into account. Thus, experience shows that the display of a continent arranged according to the subdivisions of general geography takes up less space than one organized according to the regional principle. For a regional display more individual material is generally required, both for the exhibits themselves and for the contingent preparatory work. For these reasons a regional arrangement of each section will not be possible at first, although this arrangement is the best because it is truly geographical.

Furthermore, it is not necessary that the same principle of arrangement be maintained throughout the museum. Variety will, in general, stimulate the interest of the visitor. Indeed, this device will frequently commend itself in order to bring out the individuality of the region under consideration. In the case of continents of uniform structure, such as Australia and Africa, the dynamic principle will be more appropriate than in the case of such diversified continents as Europe and Asia. In the Museum of Regional Geography in Leipzig Africa is displayed according to the dynamic principle; the South American section, on the other hand, consists of a general survey

[3] Although the name of the museum has been retained in its original form, its exhibits now deal with general geography as well as regional geography.

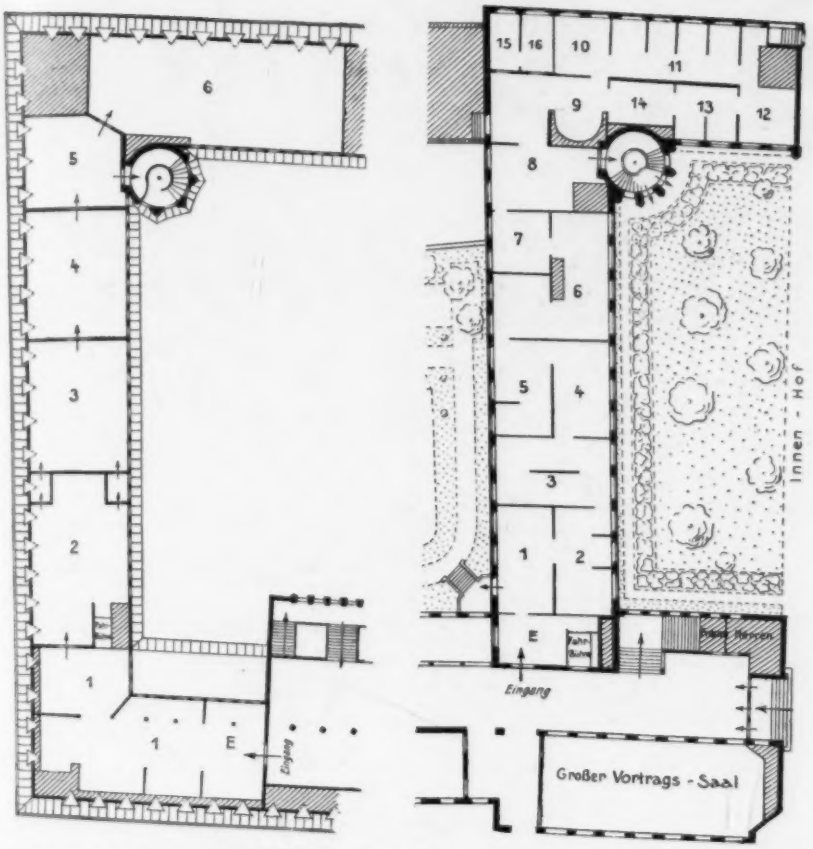

FIG. 1—Plan of the Leipzig Museum of Regional Geography. On the left, second-floor plan, exhibits of economic geography: 1, food stuffs—cereals, meat, sugar; 2, beverages—tea, coffee, cocoa; 3, industrial plants—rubber, cotton; 4 and 5, mineral products—4, coal and lignite, 5, iron ore. On the right, ground-floor plan: Africa (rooms 1–7): 1, discovery and exploration; 2, landforms and structure; 3, climate and hydrography; 4, plant and animal life; 5, population and settlement; 6, man at work; 7, Africa in the political world. South America (rooms 8–16): 8, landforms and hydrography; 9, climate; 10, plant and animal life; 11, population, settlement, trade and communications; 12, Brazil; 13, Argentine Republic and Chile; 14, Ecuador; 15, discovery and exploration; 16, Stübel room.

according to the dynamic principle, followed by the presentation of the individual areas in detail according to the regional principle.

The classification of the exhibits in general geography into major units offers no problem. The normal sequence is from the geographical aspect of geology and physiography by way of climatology and hydrography to plant and animal geography and from these to human geography in all its branches, culminating in economic geography.

Whatever the principle of classification one may follow, the arrangement according to sections and the grouping of the individual exhibits constitute a more important and more difficult problem. Before discussing this we must briefly consider visual material in its special application to museum technique.

Visual Material and Museum Technique

As is the case for geographical description, so for geographical museums also the most important medium of visualization is the map. The map is the point of departure and the medium of transmission for every given topic. Around it are to be grouped for further

Fig. 2—The active volcano of Sangay (5323 meters) seen from the southwest. From the original painting by R. Troya, Stübel collection.

elucidation relief models and photographs, drawings and diagrams, working models and dioramas. Those among the exhibits that are three-dimensional—objects that, in book or classroom, it is not possible to employ, at least not in the same degree—represent an important amplification of the range of visual material, especially for the general public. However, they also present a certain disadvantage in that they may easily lower the standards of representation, and for this reason they must be used only when exact scientific data for their representation are available and when a craftsmanlike execution is assured. The high cost of exhibits of this type restricts their use, and it is well that it is so.

Museums are intended for the general public as well as for the specialist; they must therefore be effective not only as to content but also as to form of display, so as to arouse the interest of the visitor who at first may be indifferent. For this reason maps as the main visual tool of a geographical museum must be prepared in a different manner from ordinary maps. To convey their message, color and line and lettering must be handled in a special way. The maps must be clear and pleasing in effect and must appeal to the aesthetic sense; in short, they must be works of art. Such results can be attained

only by means of original hand drawing; and it takes, to produce them, a cartographer of competence with an aesthetic color sense and a feeling for the appropriateness of the setting within a given exhibition room. The Leipzig Museum of Regional Geography lays stress on the production of artistically pleasing maps without, of course,

FIG. 3—The Mawenzi peak (5270 meters) of Kilimanjaro; bush country in foreground. From the original painting by E. Platz and R. Reschreiter.

thereby sacrificing the demands of scientific accuracy and method. Printed maps are on principle not displayed in the Museum in the development of the various topical and regional themes.[4]

The same principle applies to pictures. Only original paintings and photographs are used. Paintings and colored drawings are superior to all other forms of pictorial representation because of their use of colors. If we imagine nature without colors, we can realize how much even the most diversified landscape would lose in attractiveness and intimacy from such a deficiency. Only an original painting can render with some degree of truth the colors of nature with their thousandfold tints and shadows. Printed color reproductions are almost always disappointing. Paintings and drawings have the further advantage that they make it possible to emphasize the essential traits of a landscape or of an individual geographical phenomenon and to relegate the unessentials to the background.

A form of drawing much used since its introduction by W. M. Davis, and one that lends itself well for exhibits in geographical museums, is the block diagram. Although often more or less schematic,

[4] The displays of German topographic maps mentioned below do not, of course, invalidate this statement.

it by no means need be unaesthetic in appearance. In common with other pictorial representations of relief, the block diagram makes it possible to bring out the characteristic surface features with special emphasis. It serves admirably to represent a gradational sequence in a process series. As geological structure can be shown in cross section along the edges of the block, it is in addition an excellent device to represent the relation between the surface features of a region and its internal structure.

Photography, as compared with other methods of pictorial representation, has the advantages of completeness and literal truth. All details of the objects with which terrestrial space is filled are included and represented in their correct shapes and proportions. However, therein lies a weakness of photography: the plethora of details creates a confused effect, all the more so because the photograph gives equal weight to all objects that are at the same distance from the camera. It does not differentiate between essential and unessential; indeed, it often reverses the true conditions by subordinating the major lineaments of a landscape to the relatively unimportant aspects of the foreground. It is precisely this weakness that is usually absent in aerial photographs, owing to their embracing a wide area. Another disadvantage of photography is that it lacks color. In spite of all recent progress, color photography has not yet reached that degree of perfection that would make it utilizable in geographical museums. Thus, in the representation of large areas and far-flung landscapes, which are those that most come into consideration, it fails even more pointedly than in the reproduction of details. Furthermore, in museums color photography is practicable only in the form of glass transparencies: this means a further restriction of its usefulness.

As to paintings, drawings, and photographs, it applies with equal force that they add maximum museum effectiveness only when geographical truth is combined with artistic excellence. For an artist to be a geographer at the same time or a geographer to be an artist is a combination that unfortunately does not occur any too frequently. But what does not emanate from a single individual can be created by coöperative endeavor. If the creative artist or the photographer works with the assistance or under the direction of a geographer, work of the highest excellence often results.

The Leipzig Museum contains valuable exhibits relating to South America and Africa that owe their quality to such a union. Alphons Stübel was accompanied on his travels in South America by the native painter Raphael Troya, Hans Meyer in Ecuador and Africa by the Munich artists R. Reschreiter and E. Platz. How discouragingly small is the number of geographically valuable pictures in the enormous amount of photographic material available through the usual commercial channels is familiar to every one who has tried to

make a systematic collection of geographical pictures. How greatly, on the other hand, the value of photographs increases when taken under geographical direction or from a geographical viewpoint is illustrated by the splendid photographs of Johnson and Shippee.[5]

Among three-dimensional devices of visual representation the relief model is the most valuable for geographical museums. The

FIG. 4—Relief model of the Lilliehöök Glacier, Spitsbergen. Original on the scale 1 : 25,000. (By Professor Dinges, Landesberg on the Lech.)

flexibility as to choice of scale, method of construction, and distributional coloring insures to relief models an important rôle in geographical-museum implementation. An important advance in the construction of relief models has been made by a Munich firm, which has made it possible to produce mechanically by the Wenschow process geographical models with remarkable fidelity of detail.[6] Its relative inexpensiveness permits a free use of this important type of exhibit, which is particularly useful in the case of models with no or only slight vertical exaggeration. For reasons associated with the laws of human optics the upper limit of visible exaggeration has been found to be one and a half. The Leipzig Museum possesses about 50 relief models of varying horizontal scales that meet this condition.

SELECTION AND ARRANGEMENT OF MATERIAL

The various types of visual materials whose suitability for geographical museums has been briefly sketched can fulfill their purpose only if, properly selected and arranged, they are grouped to form a homogeneous, appropriate whole. In consonance with the task of

[5] George R. Johnson: Peru from the Air, *Amer. Geogr. Soc. Special Publ. No. 12*, 1930; Robert Shippee: The "Great Wall of Peru" and Other Aerial Photographic Studies by the Shippee-Johnson Peruvian Expedition, *Geogr. Rev.*, Vol. 22, 1932, pp. 1–29; *idem:* Lost Valleys of Peru: Results of the Shippee-Johnson Peruvian Expedition, *ibid.*, pp. 562–581.

[6] K. Rathjens: Das neue Wenschowsche Reliefverfahren, *Petermanns Mitt.*, Vol. 68, 1922, pp. 4–5.

geography as a science it is likewise the function of a geographical museum in the first place to portray, by means of various forms of representation, the spatial and causal interrelations among the different elements of a region or of an individual geographical phenomenon and thus to make them clear to the museum visitor. As the next step it is the business of a museum to see to it that the impressions that the visitor has received from the individual materials are focused in his mental eye to that unity of the whole that corresponds to the geographical reality of the topic or region represented. He must be led to synthetic visualization—to be made to think unitarily ("ganzheitlich"). This can be achieved by so arranging the exhibits that they will represent a clean-cut and self-contained group that is readily visible as such. The group makes it possible for the visitor to sense instinctively, as it were, the inner relationship of the individual materials displayed as well as their common bearing on the theme under consideration. In turn, the groups representing individual themes should be so arranged in order that they will be readily recognized as representing a progression in the treatment of the major topic. The selection of the materials for a group and the arrangement of the groups to form the larger visual units constitute one of the most difficult but also one of the most fascinating problems to be solved in the organization of a geographical museum.

The Goal of Synthetic Visualization

How the goal of synthetic visualization may be attained by means of the different mediums available will now be discussed on the basis of an example each from regional geography and general geography.

In the South American section of the Leipzig Museum[7] one of the walls of the alcove devoted to the Andean countries is taken up with the display relating to the Peruvian coastal belt, a desert coast that, however, as a result of irrigation carried out by means of the rivers descending from the mountains has attained great importance in the national economy of Peru. The main map in this display shows the distribution of all the phenomena that come into consideration. It shows the main features of the relief; the limits, exclusive of the true desert, of the arid and humid districts as conditioned by the climate; the irrigation oases and the settlements; and the most important lines of communication. An air photographic map shows the pattern of cultivated land—many small fields in the older areas and larger units in the areas of holdings recently constituted. This map reveals the relation between agriculture and irrigation and thus explains the origin of the oases of the coastal belt. Paintings and photographs portray in its various forms the landscape from the edge of the Andes

[7] On this section as a whole see the article by the writer, "Die Südamerika-Abteilung des Museums für Länderkunde zu Leipzig," *Ibero-Amerikanisches Archiv*, Vol. 5, 1931, pp. 235–241.

FIG. 5

FIG. 6

FIG. 5—Exhibit of the mining industry of Chile.
FIG. 6—Exhibit of the Arctic flight of the *Graf Zeppelin* in 1931 and its results.

to the coast: on the one hand we see the landscape in its natural condition, with uncontrolled river courses and without settlements and major lines of communication, and on the other we see it in the

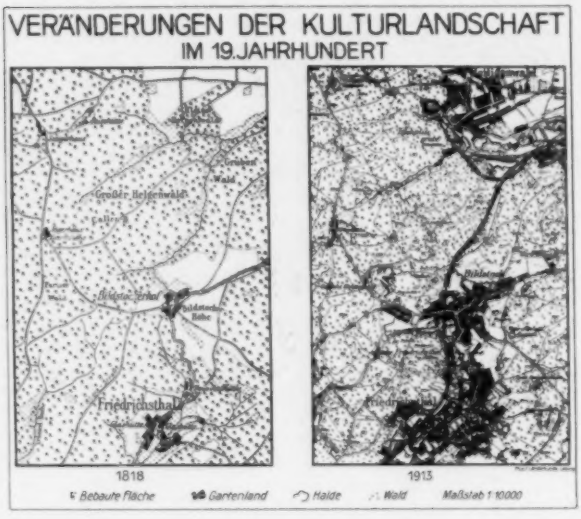

FIG. 7—Map from the special Saar Basin exhibit, illustrating the transformation of the cultural landscape in the nineteenth century. The scale of the original is 1 : 10,000 (this reduction approximately 1 : 90,000).

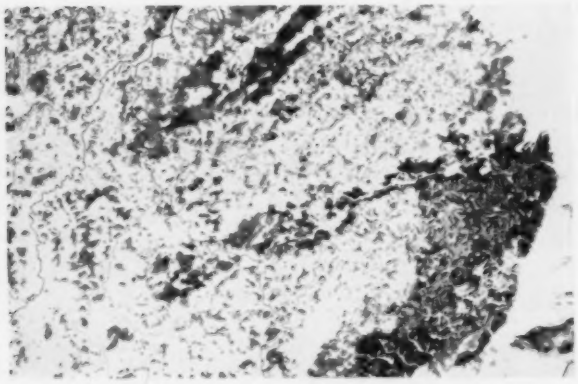

FIG. 8—Map from the special Saar Basin exhibit showing the distribution of woodland. Three types of woods—deciduous, coniferous, and mixed—are distinguished. Scale of original 1 : 100,000.

form as modified by man, with regulated water courses, diversified cultivation, and wide roads for vehicular traffic, with, furthermore, the settlement sites and types as conditioned by soil and topography, and, finally, with the contrasting forms of agricultural economy as illustrated by the small farms of the natives and the large modern haciendas managed by Europeans. Diagrams illustrate the yields of agriculture during the last decades as regards its two main products, cotton and sugar; they also indicate the Peruvian share of world production of these staples. In a show case samples of Peruvian cotton and cotton products are on display. In the same way are dealt with other regional units, such as the urban unit of Greater Lima, the

Bolivian mining areas, the Gran Chaco, the economic areas of Chile in different latitudes, and others.

In the section of economic geography the exhibit devoted to

FIG. 9—Map from the special Saar Basin exhibit of an important area on the Saar-Lorraine border.

At the points indicated workings have been carried out underground in the Saar from shafts sunk on French territory. Scale of the original 1 : 25,000 (this reduction about 1 : 400,000).

FIG. 10—Model from the special Saar Basin exhibit illustrating the distribution of population as it is localized in the basin.

coal (Steinkohle) is now being organized. Here the display begins with a mural of a coal forest. This reconstruction has been painted by an artist according to the data furnished by, and under the constant supervision of, a geologist. All the plant forms to be seen in this mural are displayed in a number of show cases as fossils, arranged according to species. Geological and topographical maps indicate the world distribution of coal. Important areas such as the Ruhr and the English and the Pennsylvanian coalfields are emphasized in special maps on a larger scale. Relief models showing coal strata and underground mines, core samples, and models of drilling machinery and derricks illustrate the mining of coal. Paintings, drawings, and photographs show the coal miner underground

and the typical surface landscape in important coal districts. Graphs and cartograms contain data relating to the coal production of the world and the main coal areas as well as to the trade in coal and coal consumption. A collection of samples of the different kinds of coal on the market, with notes on their heating capacity and their appropriateness for different purposes, together with models, constitutes the exhibit consisting of actual objects. The general line of thought developed thus leads all the way from the coal forest to the distributing syndicate, and the individual relationships that the concept of economic geography, "production of coal," bears to the climate and the vegetation of prehistoric time, to present geological conditions, to the cultural landscape of the coal areas, to the density and the mode of settlement of the population of these areas, and to world exports and imports of coal are revealed by various visual methods. In this way the synthetic concept is obtained that corresponds to the topic to be represented.

Status of the Leipzig Museum

In conclusion, a few words as to the present status of the Museum of Regional Geography in Leipzig may be added.[8] On the side of regional geography, Africa and South America are the continents first selected for treatment, because of certain considerations relating to the early history of the Museum. North America and Europe will follow as soon as money is available. On the side of general geography, a part of Stübel's volcanological collection is on display, and a section devoted to economic geography is under way. The scope and arrangement of these sections are such that they naturally fall into the plan of the Museum as a whole.

In addition to the more general representation of whole continents a number of smaller areas are given intensive treatment. At present a section devoted to Germany is under preparation. Occasionally topics of limited scope are illustrated in special exhibits. All current events or questions of timely interest that call for geographical knowledge provide the motivation for such exhibits. Thus a special display was built around the renewed volcanic activity of Etna in 1928. Similarly, the news dispatches in 1930 concerning the finding of additional Franklin relics and of Andree's remains as well as the Arctic flight of the *Graf Zeppelin* in 1931 prompted relevant exhibits. The most important display of this sort was the German Saar Exhibit,

[8] Among pamphlets issued by the Museum dealing with its organization and collections may be mentioned: "Das Museum für Länderkunde zu Leipzig: Seine Geschichte, seine Aufgaben und Einrichtungen nebst vorläufigem Führer durch die Sammlungen," 28 pp., 1929; "Führer durch die Ausstellung Afrika-Ostafrika" (in honor of Dr. Hans Meyer on his seventieth birthday), 24 pp., 1928; and "Erläuterungen zu Afrika, Raum 1, 2, 3, 6," 1931. Independent descriptions of the Museum have appeared in *Geogr. Zeitschr.*, Vol. 35, 1929, pp. 40–44 (by H. Schmitthenner) and *Geogr. Anzeiger*, Vol. 30, 1929, pp. 42–46 (by A. Liebold).

which was shown first in Leipzig in 1930 and then in other large cities in Germany; this exhibit was arranged in connection with the forthcoming plebiscite in the Saar district in 1935. A permanent special exhibit in the entrance hall of the Museum deals with new issues of German official maps. Every new sheet published is on display there for one month.

While the regular and special exhibits are the most conspicuous expression of the work of the Museum, its activities are shown in a number of other ways. Some of these are contributory to the creation of the exhibits; others serve other purposes. Among the most important of these are the "Explorers' Archives," a collection of original geographical material that geographical explorers and scholars have collected and prepared on expeditions or other major scientific undertakings and that is here to be preserved from dispersal and loss. Recently these archives have been enriched by the receipt of the entire original material of the German Antarctic (*Gauss*) Expedition of 1901–1903. The archives further contain manuscripts, correspondence, and similar material. As a corollary a collection of photographs of geographical explorers is maintained.

As a basis for its work the Museum has at its disposal the following collections: a geographical library, a comprehensive map collection, a collection of original paintings and drawings and of current and old photographs, a collection of lantern slides, and a wide range of rock specimens and samples of raw materials. All these collections are classified and catalogued according to geographical principles. The Museum has a drafting department of its own, a photographic laboratory, and a bookbindery. The dispatch of, or participation in, scientific expeditions forms part of the program of the Museum. As yet it has not been possible to carry out this phase of its work, owing to lack of funds. On the other hand, a series of publications entitled "Wissenschaftliche Veröffentlichungen," of which an earlier series existed, has again been issued as a new series since 1932. This series is to contain major contributions in all departments of geography and is to appear annually.

The organization of the Museum is thus complete in its broad outlines, although the space available and the size of the staff for the time being are not sufficient to carry out adequately the great educational, scientific, and national tasks incumbent on it.

THE DISTRIBUTION OF POPULATION IN THE LAKE ST. JOHN LOWLAND, QUEBEC*

Robert M. Glendinning
University of Michigan

FAR back in the wilderness of the Laurentian Shield, about one hundred miles north of the city of Quebec and a like distance west of the mouth of the Saguenay River, is an island of population which occupies the plain of unconsolidated sands and clays surrounding the low shores of Lake St. John.[1]

The widespread settlement of the plain, carried out predominantly by agricultural people, began in the year 1851, when M. l'Abbé Hébert succeeded in establishing in the southeastern part, at the present site of Hébertville, a colony of French-Canadian farmers from the St. Lawrence Valley.[2] Since that year the settlement has spread westward and northward until today, with an occasional hiatus, it encircles the lake. It has retained its original characteristics so that, in spite of the recent introduction of three pulp mills and one large hydro-electric plant, the population is more than 90 per cent composed of French-speaking farmers.

The bulk of the settlement is associated with adequately drained clay-loam soils. This relationship is shown in Figure 1. On the other hand, the lack or paucity of population in certain sections is indicative of the presence of swampy conditions or extremely sandy soils. These conditions are reflected in the population statistics. The area shown within the confines of the population map contains about 50,000 persons, the vast majority of whom are found in the lowland. In the lowland itself the actual number varies greatly from place to place. In the whole of swampy Racine canton there is not a single inhabitant, while in the more favorable parts a single areally inconspicuous agglomeration, such as Hébertville, may contain more than a thousand persons.

The principal exception to this general condition is found in the vicinity of Dolbeau. Here, owing to the presence of a large pulp mill and also of woodcutting camps in the adjacent upland, many are able to eke out a living through part-time employment as mill hands or lumberjacks.

The distribution of population in terms of pattern, if not unique, is certainly unusual. In order to describe this pattern it is necessary

* Part of a regional study of the Lake St. John lowland to be published in 1935 in the *Papers of the Michigan Academy of Science, Arts and Letters*, Vol. 20, 1934. The field work in the area was done during the summers of 1931 and 1932.

[1] John A. Dresser: Part of the District of Lake St. John, Quebec, *Canada Geol. Survey Memoir 92*, 1916, pp. 3, 4, and 48.

[2] André Laliberté: Les Fêtes du Monument Hébert à Hébertville, Lac Saint-Jean, 6 Juillet, 1926. Le Syndicat des Imprimeurs du Saguenay, 1926.

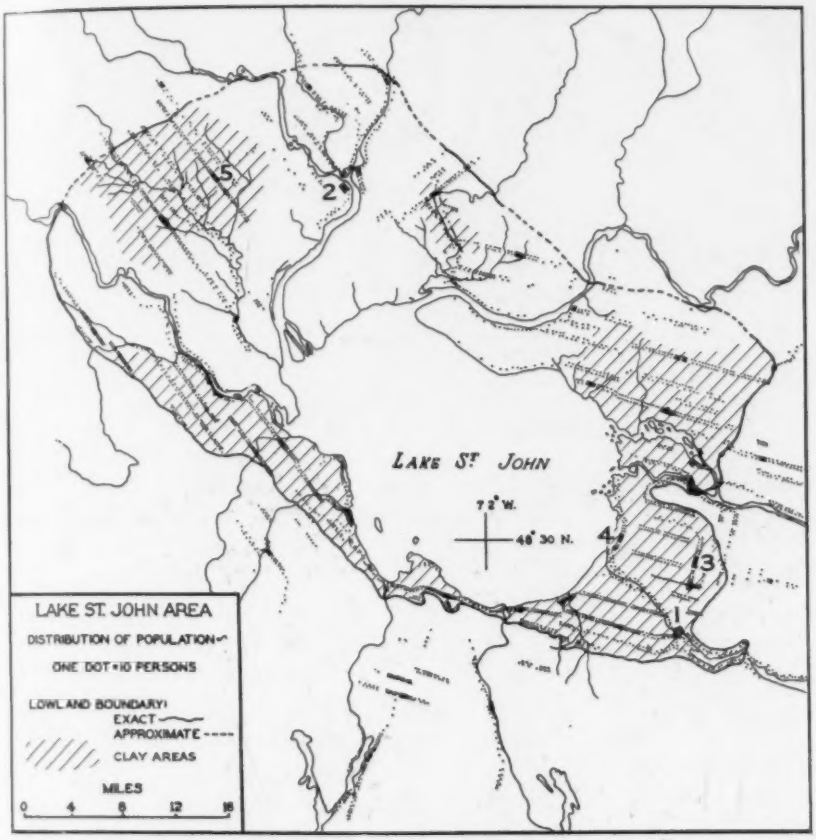

FIG. 1—Distribution of population in the Lake St. John area. This map was prepared on the basis of field work, the study of vertical and oblique aerial photographs, and statistics obtained from "L'annuaire des comtés de Chicoutimi et du Lac St Jean," Chicoutimi, 1929; and "Statistiques municipales pour l'année civile 1929," Bureau of Statistics, Quebec. The major clay areas are shown by ruling. They are: 1, Hébertville; 2, Dolbeau; 3, St. Bruno; 4, St. Gédéon; 5, Albanel.

to explain the system of survey and its relation to the road pattern. The reason for this procedure lies in the fact that population hugs the edges of the roads, and the roads with few exceptions follow the lines of survey.

The lowland is divided into survey divisions known as cantons. The cantons are of differing sizes and follow no regular pattern of arrangement (Fig. 4), but, regardless of area or position, each canton is divided into long, narrow strips known as ranges. Each range is further divided into still smaller strips called lots. A lot is ordinarily one mile in length and one-sixth that distance in width, with its longer dimension oriented at right angles to the length of the range (Fig. 4). This lot system of land survey was brought into the Lake St. John region from the St. Lawrence lowland, where it was in use even in the early days of French colonization in North America. The cantons

FIG. 2—Vertical aerial photograph of St. Bruno and vicinity. The top of the picture is east. (Photograph by Royal Canadian Air Force.)

FIG. 2—Vertical aerial photograph of St. Bruno and vicinity. The top of the picture is east. (Photograph by Royal Canadian Air Force.)

FIG. 3—Oblique aerial photograph of St. Gédéon and vicinity, looking southeast. (Photograph by Royal Canadian Air Force.)

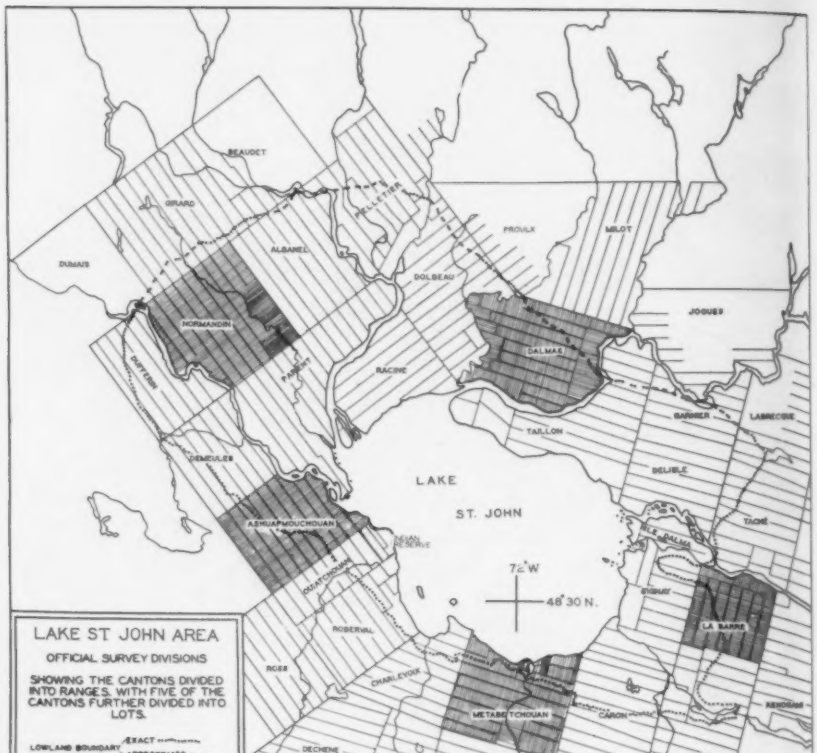

FIG. 4—Land division in the Lake St. John area. Based on the "Carte régionale du Lac St. Jean, comprenant les cantons arpentés," Department of Colonization, Mines, and Fisheries, Quebec. 1923 and 1929 issues.

are so placed that the ranges of adjacent cantons often meet at sharp angles or, owing to differing area and the lack of a common base line, may not coincide even when they have the same trend. The survey pattern, then, resembles a crazy quilt of ranges and lots.

The roads of the plain follow either the lot lines or the range lines, producing a sort of broken spider-web pattern with sharp, right-angle turns. The pattern is broken because of the lake and the absence of thoroughfares in most of those portions of the lowland that are swampy or sandy.

As noted above, the population lives literally on the sides of the roads but, owing to the character of the survey, chooses only roads that lie along range lines and avoids those that follow lot lines. The farmer builds next to the range-line road for various reasons, among which looms the advantage of being able to get his horse or team directly on the thoroughfare during the heavy-snow period of the long cold season. Even in the villages, where lots may have been

further divided longitudinally, the same relationship creates a *strassendorf* here and there on the range-line roads. The complete condition described above may be illustrated by two airplane photographs. In Figure 2 the nearly north-south road follows a range line—note the settlement along its course and the concentration that is the village of St. Bruno. The lot-line roads, at right angles to the main artery, have no settlement along them. This same photograph also shows, in the arrangement of the fields, further effects of the lot system of land survey. In Figure 3 is given a typical sequence of lake, plain, and highland background. The settlement near the water is along a range-line road. The population line appearing farther back, near the center of the picture, is also along a range line, but at right angles to the first—the reason being the use of different base lines in laying out the ranges. The two lines of settlement do not connect, even though the roads do. As a consequence of these arrangements, there is produced in the plain a linear and yet disconnected pattern of population distribution.

Another conspicuous aspect of the settlement pattern is the distribution of churches. Just as the distant factory chimneys foreshadow one's approach to a manufacturing town, so the spires of the churches herald the presence of the villages in this region. One can choose almost any range-line road in the clay portions and, allowing his eye to follow the lines of the farm dwellings, can easily discern the dominating spire in the distance. A profile along such lines of settlement would lie close to the earth from the farms to the heart of the village, at which point it would form a peak with the spires before continuing at its former level.

PEAT-LAND UTILIZATION

A. P. Dachnowski-Stokes

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DEPOSITS of peat constitute one of our important natural resources. They are widely distributed, covering altogether an area of nearly 150,000 square miles. The utilization of the deposits, however, is subject to peculiar technical difficulties. There is need for practical information to direct selection of the more suitable areas for the production of food and forage crops, to guide manufacturers of peat products to advantageous supplies of raw material, and to turn the less desirable deposits to pasture or to such uses as reforestation, protection of water sources and water-storage basins, wild-life reserves, or purposes of scientific research.

The aim of this paper is to outline the available information on the natural characteristics of peat deposits and on their variations, local and regional, as indicative of their economic utilization. At least three conditions of fundamental importance limit the agricultural and industrial uses of peat deposits by individuals and communities.

The Great Regional Groups of Peat Lands

The first limiting condition arises from the relatively wide geographical distribution of our peat deposits. This regional factor is difficult to describe and almost impossible to measure economically, because it depends upon a combination of climate, land relief, and character of the vegetation forming peat soils. Geographical study of the peat soils of the United States as a whole has been sadly neglected. Valuable studies of individual areas have been made, but their restricted nature precludes comparison of the frequency of certain typical profiles and of the volume range of economically important layers of peat contained in them. For the same reason the more significant genetic features and the properties of peat soils resulting under different conditions of climate, surface vegetation, and age relations are not well known. It is not possible to give more than the outstanding differences between regional groups of peat lands[1] and the more striking relationships that bear upon various matters of utilization.

The Northern Peat Lands

The first regional group of peat deposits to be discussed occurs in the cool-temperate and humid part of the United States and com-

[1] The important characteristics and relationships of the major groups, their subdivisions, and the distribution of each have been set forth by the writer in "American Peat Deposits" (Handbuch der Moorkunde, Vol. 7, Berlin, 1933, pp. 1–140).

prises three subdivisions, confined chiefly to northern New England, to the northern Great Lakes states, and to the Pacific coast in northern Washington whence it extends into Alaska. The deposits of this group are relatively recent in origin and not decomposed to any great degree. They include flat and raised bogs, heaths, coniferous swamp

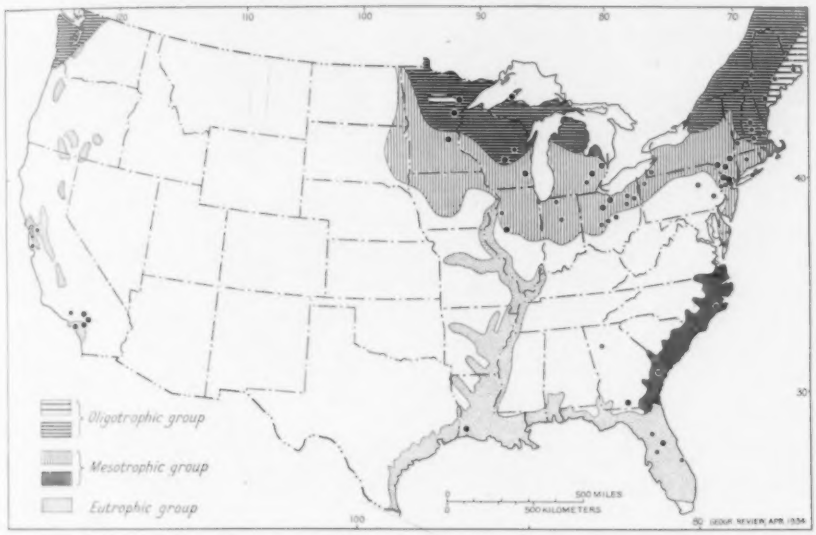

FIG. 1—Map of the United States showing regions in which the major groups of peat land occur. The grouping is associated with the main character of environmental conditions (climate and vegetation) in connection with an abundance or deficiency of soil constituents influencing growth reactions. Subdivisions have been outlined on the basis of the origin, development, and past history of peat deposits in relation to land relief, and on the characteristic properties of distinctive type profiles. Scale of map approximately 1 : 37,500,000.

The map also shows the location of plants reported to produce peat products. (Data in part from *U. S. Bureau of Mines, Bulletin 253*, 1926.)

forests, and deposits of a transitional character in different stages of profile development, but it is the members possessing a surface layer of sphagnum-moss peat that are most truly representative of the normal geographic and climatic conditions of the region.

The name "oligotrophic" has been applied by the writer to the group because the soils are generally deficient in plant nutrients. They are strongly acid in reaction, poorly decomposed and spongy fibrous, high in water-holding capacity, and highly leached, the percentage of available nitrogen and mineral salts, notably lime and potassium, being very low. In regions of heavy rainfall the upper layers lose considerable quantities of mineral material by the solvent action of percolating water containing carbon dioxide and by organic matter acting in the absence of oxygen.

Efforts at utilization of the deposits have been largely in the direction of hay and potato crops, stock farming and dairy products, the culture of cranberries and blueberries, and the growing of native

commercial timber. Their utilization should, however, be restricted to their particular adaptabilities. Conservation of the natural timber resources should be a major purpose (Fig. 2), especially on deposits that are moderately drained and where the surface layer of moss peat is shallow. Areas with thick layers of sphagnum-moss peat should be retained for the conservation of water supplies and preserved

FIG. 2—Coniferous swamp forests in the northern Great Lakes states are needlessly lying in waste. They should provide game preserves and a future timber supply. The botanical composition and degree of decay of the peat layer below the surface determine largely the growth of the trees.

as primitive localities for scientific research, as wild-life reserves, and as state or federal parks. Certain grades of poorly decomposed reed-and-sedge peat, though low in fertilizer value, should supply the existent need for domestic peat products to improve mineral soils. The dome-shaped heaths in northeastern coastal Maine and some of the extensive flat bogs in Minnesota contain moss peat of commercial significance, comparable in quality to that imported from Europe.

THE CENTRAL CONTINENTAL GROUP

The principal deposits of the second group of peat lands form a belt extending from New Jersey and New York to Ohio, Illinois, Iowa, and South Dakota. Several subdivisions may be distinguished, but the common regional qualification is a surface peat soil developed under conditions of mixed coniferous and deciduous swamp forests. A more or less complex profile structure, which usually includes units of a transitional character with surface layers of reed-and-sedge peat, is one of the chief developmental features. The soils are darker in color than those of the first group, have a higher content of organic residue, soluble nitrogen, and mineral matter, and show moderately acid to alkaline reaction. The lime requirements of the group are

closely related to the nature of the ground water and underlying mineral soil, but the reaction of the surface material is variable, indicating that part of the soluble material is removed by leaching. The name "mesotrophic" has been proposed by the writer for the group on the basis of the significant though low content of soluble plant-food constituents released under the influence of moderately

FIG. 3—Cleared tracts at the edge of deciduous swamp forest on peat deposits in the Erie-Ontario Basin of New York. This land is used for the production of such vegetables as onion, celery, cabbage, lettuce, and spinach. (Photograph by B. D. Wilson.)

long summers, favorable rainfall, greater depth of decomposition, and the modifying effect of the underlying mineral soils of the region.

The agriculture of the group is characterized by its variety, including small grains and stock farming, fiber plants, and forage and root crops, by the use of the better type of swamp forests for wood-lot management, and by the development of intensively cultivated specialties such as onions, celery, cabbages, sugar beets, and peppermint (Fig. 3). The use of fertilizers, particularly those containing potash and phosphoric acid, produces marked increase in crop yields. However, acreage and production are very uneven, and large areas of peat land are now almost devoid of cultivation, in some cases through lack of economic adjustment. The commercial production of domestic peat products is almost wholly confined to the utilization of reed-and-sedge peat in a partial degree of decomposition. A fairly large output is in the form of shredded and cultivated grades used as a source of organic matter for improving mineral soils.

A belt of peat deposits, chiefly those of the Dismal Swamp and of canebrakes on the Atlantic coastal plain from Virginia to Georgia, embraces peat soils that, taken as a whole, are in some respects like the organic material of the second group. They are, however, much poorer in their natural condition, being generally more thoroughly

leached, strongly acid, and of inferior structural character. Their basic economic utility is for timber production, as wild-life reserves, and as water-storage basins.

The Southern and Western Group

The third main group forms a southern and western belt developed under a predominantly grass-like cover subject to periodic flooding and consisting chiefly of organic remains from marshes of saw grass,

Fig. 4—Large areas in the Florida Everglades consist of sawgrass peat. They are in need of protection against serious wastage through over-drainage and fires. The rate at which peat soils are destroyed under a semitropical climate makes it imperative to aim at a complete control of ground-water conditions. (Photograph by R. V. Allison.)

tule, reeds, sedges, and similar plants. Outstanding subdivisions are the subtropical Everglades of Florida, the semiarid peat land of California, and deposits in the valleys of the Mississippi River and of the Klamath and Willamette rivers in Oregon.

The distinguishing group features of these peat soils, defined on the basis of their own peculiar profile characteristics and regional conditions, are the brown to grayish-dark brown color of the well decomposed granular organic residue and its mildly acid or nearly neutral to strongly alkaline reaction. The group is technically designated as "eutrophic" because the peat soils are relatively unleached and comparatively well supplied with soluble salts, showing in places a tendency to accumulate salts of the alkalies or alkaline earths near the surface. Evaporation is high, and the salt constituents become concentrated in the upper layers: they may separate out as efflorescences on the surface of drained peat areas or, under certain conditions, may form a special type of saline and alkaline peat land.

The list of crops is varied and includes important acreages in early vegetables. Rice and, to a less extent, sugar cane are among the

natural crops of the region, but agriculture must in general be practiced with the assistance of irrigation (Figs. 4 and 5) and by the application of fertilizer elements such as copper, zinc, and other heavy metals that are less commonly regarded as necessary for plant growth. The better grades of sedge, tule, and reed peat of this group afford possibilities for manufacturing peat products. The dark-colored, partially decomposed materials are chiefly useful in improving the physical properties of mineral soils.

FIG. 5—Irrigated area of tule-reed peat in the Klamath region of Oregon. This undertaking has been carried out with a prospect of success but many other reclaimed areas are alkaline and unfit for agriculture. They should be restored to the natural condition and serve as refuge for wild life and as a feeding and resting ground for migratory birds. (Photograph by W. L. Powers.)

To these three main groups may be added a fourth, the maritime group, comprising peat and muck on or near the sea shore and developed in brackish and salt water. The group includes two regional subdivisions, salt marshes such as exist along open bays and estuaries of northern coastal states and mangrove swamp forests and tidal marshes of tropical coasts and islands. The name "halotrophic" has been applied to the group, in reference to its saline character and the inhibiting influence of excessive amounts of salts, a serious drawback to use for agricultural purposes or for improvement of mineral soils.

THE BASIC DIFFERENCES BETWEEN PEAT DEPOSITS

The second fundamental factor governing the utilization of peat deposits lies in the profile sequence of the component layers. In general several kinds of peat occur superimposed on one another and differing in character, thickness, and relative arrangement.

The morphological characteristics of the entire vertical section of a peat deposit afford one of the most important means of appraising

its economic value. By this means it is possible to differentiate between subdivisions of the main groups of peat land, whose structural characteristics have been produced under different environmental conditions. The profiles also bring out essential differences in regard to drainage conditions, shrinkage, and the requirements for cropping systems.[2]

Profile features are generally recognized as the product of a succession of natural vegetation stages and as being closely connected with the topography of the locality. Peat deposits are conveniently separated into two classes—those that have developed inward toward a center in basins containing a body of standing water and those that have originated on a flat surface and expanded outward owing to the very slow rate of water movement through accumulating plant remains. The former need expensive drainage measures for reclamation; the latter can be drained to the bottom, with an outlet for any excess of a rising or fluctuating water table.

Areas of peat that had their origin in open-water basins usually exhibit a characteristic sequence of three main layers. Starting from the base these are: a layer of organic sediments deposited below the surface of free water and easily distinguished by the fineness of grain and the soft, almost jelly-like consistency; an overlying fibrous material, having the characteristics of a firm, interwoven mat developed under conditions of shallowing or fluctuating water level; and a surface layer of woody peat that contains fallen timber, stumps of trees, leafy litter, and various residues exposed to aeration and decomposition.

However, not all pond-formed deposits show the normal series of layers. In very large water basins the sequence may remain indefinitely in the initial (sedimentary) stage of peat formation or may stop without further change at the intermediate (fibrous) stage. Since water stands on or near the surface the greater part of the year and artificial drainage is difficult if not impossible, most of the basin-shaped, water-formed units of peat land of greater depth than 10 to 15 feet should be withdrawn from cultivation and temporarily abandoned or be conserved for objectives set by national policies. Pond-formed deposits are subject to greater shrinkage and injury from frost than any other type of peat land. They should be valued mainly on the basis of public needs for conservation or, if they support tree growth, for the quality and stand of merchantable timber.

In contrast with the above is the sequence of layers in peat deposits originating on plains, terraces, and land of low relief originally wet or under moderately fluctuating ground-water conditions. In profiles

[2] Inherent structural differences between peat deposits and consequences of these are pointed out by the writer in "Factors and Problems in the Selection of Peat Lands for Different Uses," *U. S. Dept. of Agric., Dept. Bull. No. 1419*, 1926. Physical and chemical characteristics of various entire profiles have recently been described by I. C. Feustel and H. G. Byers: The Physical and Chemical Characteristics of Certain American Peat Profiles, *U. S. Dept. of Agric. Technical Bull. No. 214*, 1930.

of the "built-up" units of peat deposits the basal layer may consist of fibrous or of woody peat of various kinds. The vertical development may have gone along the same course, or it may have been in an abnormal direction, owing to retarded outflow of water, or, because of some later change in the controlling factors of the environment, it may show a more or less complicated sequence of layers. For example, certain profiles consist chiefly of one layer of woody peat, while others record a succession beginning with a layer of fibrous peat succeeded by one of woody material overlain by a layer of moss peat caused by a change to cooler and moister atmospheric conditions. Abnormal forms of profile structure frequently terminate in a layer of sedimentary material, indicating that the area became water-logged by a gradual rise of the water table that led finally to lake conditions. Profiles of this kind exhibit an inverted series of layers, the opposite of the "filled-in" deposits formed in basins of standing water. It is important to note that the vegetation covering the surface of a peat deposit is not necessarily indicative of the number and character of peat layers below the surface; hence the need of careful consideration of the structural form of the peat profile.

Major Classes of Peat Soils and Their Uses

Of no less importance is the third condition—the nature of the layers in any given peat deposit and their degree of decomposition. Layers of peat represent the units of the structural form of a profile. They indicate the composition and make possible correlation of physical and chemical properties of peat materials both in this country and elsewhere. They are identified by the differences in kind and quantity of the plant remains of which they are composed.[3] We shall here discuss a grouping according to properties of economic significance.

Sedimentary Peat Soils

The sedimentary peat soils are composed of organic material that previously floated or was suspended in fresh or brackish water and was formed from the residue of aquatic plants and microörganisms and spores and pollen carried by the wind, with the addition of varying quantities of clay, silt, and sand. In texture the material varies from coarse to very fine particles, while in structure it may be impervious and dense or soft and plastic. It lacks firmness, and the increase in the expense of draining layers of organic sediments decreases the profit of operation. A surface layer of a thickness greater than five feet is generally not suitable for agricultural purposes. Shallow areas

[3] The main classes of peat are listed from both a theoretical and a practical viewpoint in A. P. Dachnowski: Quality and Value of Important Types of Peat Material, *U. S. Dept. of Agric. Bull. No. 802*, 1919.

containing a relatively higher content of mineral matter are more remunerative. The major use of such land in virtually all parts of the country is for pasture and hay and small grains.

Three varieties of sedimentary peat soils may be distinguished: they are representative of certain soil and ground-water conditions and may occur intermixed with peat soils of other classes.

The peat mass of one variety is composed of finely divided organic matter. It is brown to black in color, acid in reaction, sticky, plastic, or gelatinous, possessing many of the properties of a colloid. When drained, the material shrinks greatly (to one-eleventh of its original dimensions), contracts into a dense mass, and, upon air drying, becomes hard and inert, showing cracks and fissures. Exposed to alternate moisture and drying, it breaks into lumps with angular fracture, crumbles, and finally weathers into a granular material.

Another variety of sedimentary peat soil is siliceous, containing quantities of microscopic bodies from diatoms and sharp-pointed spicules from fresh-water sponges. The material is gray to brown in color, very light in weight, slightly acid to neutral in reaction, and has polishing and abrasive properties. It is popularly known as "itchy muck," from the sensation experienced by workers in these deposits.

A third variety contains lime derived from the shells of mollusks and from the soft, friable, cream-colored, granular marl of stoneworts. Water containing large quantities of calcium carbonate exercises a flocculating and precipitating action on organic matter present in suspension and in colloidal solution and on compounds of iron that may be present. Where the amount of lime is too high, cultivated crops tend to become chlorotic and susceptible to nutritional disturbances.

The nature of the material and its position with reference to other layers of peat are important factors limiting its use for commercial purposes. The evidence available at present indicates that, in general, sedimentary peat soils have little industrial value.

Reed and Sedge Peat Soils

The outstanding characteristic of this class of peat is the fibrous and porous nature of the material. It has its origin in the interwoven and matted meshwork of roots and underground stems of sedges, saw grass, tule, reeds, cane, and other reed-like grasses that predominate in marsh vegetation. Reed marshes at one time, at a period of more abundant and frequent rainfall, were much more extensive over the central and western United States than now.

Because of its porosity, a fibrous layer can be readily drained, aerated, and cultivated. Under conditions of controlled drainage contact with the air, soluble salts, and microörganisms hasten dis-

integration and impart a darker shade to the reddish or yellowish brown of the parent material. But when overdrained the material remains more or less unaltered; it becomes brittle when dry and under cultivation breaks down into a fine granular dust that absorbs air but is almost impervious to water. If irrigation measures are not feasible, windbreaks of willow, birch, maple, and the like are necessary to prevent injury to seedling crops from dust storms. A rotation that includes broad-leafed herbaceous plants with a fibrous root system alternating with grasses also aids to hold the fine-grained organic residue.

Sedge and reed peats are among the most profitable for agricultural and industrial purposes. Hence the thickness of the layer of fibrous peat, its degree of decomposition, and the character of the underlying mineral soil are of the greatest importance in rating the economic value of such a deposit. Three to four rather distinct types of farming are practiced on sedge-and-reed peat.

On a poorly decomposed, coarsely fibrous variety of this class of peat potatoes and corn are considered desirable. Plowing of such peat usually causes a reduction in the growth of the crops that follow. In such circumstances applications of soluble nitrogen will be necessary. The type of fertilizer needed is largely conditioned by the kind—clay (calcareous or non-calcareous) or sand—of the underlying mineral subsoil, the former, it seems, responding more readily to phosphates, the latter requiring phosphates, potash, and, to some extent, lime.

Sedge and reed peats that have undergone partial decomposition are brown to dark brown in color, contain fine-grained organic residue in varying proportions, crumble readily, and generally give a moderately acid to neutral reaction. When properly fertilized they are well suited to the growing of celery, onions, cabbages, or peppermint, and they are fairly well adapted to the small grains. The use of potash produces marked increase in crop yields, and manure also gives excellent results. However, the major use of this type of peat land is governed by economic considerations: nearness to a market or shipping point is one of the important factors in the profitable production of vegetable crops. Moreover, on account of late frosts in the spring and early frosts in the fall, the growing season is considerably shorter on peat land in some states than on mineral soil in the same region.

Well decomposed layers of reed and sedge peats that consist chiefly of very dark brown to black organic residue are generally referred to as muck. Muck is the result of weathering, oxidation, and the action of microörganisms upon the surface material. There are considerable differences in muck because of the differentiating tendencies of vegetation, climate, and mineral subsoil. In addition, the formation of muck from peat can be accelerated by man: cultivation, cropping, and the application of manure and fertilizers hasten the transforma-

tion of fibrous peats. Many shallow deposits once under cultivation have now disappeared, leaving a black, friable mineral soil with a high humus content as an indication of their former existence. Deeply cultivated deposits of sedge-and-reed muck have as a detracting feature losses in yield from wind erosion and from accumulating plant diseases. A safer practice is the growing of hay or grain or stock farming. The expenses for fertilizer and labor are less, and there is better distribution of labor throughout the year than in any intensive form of truck farming.

The value of reed-and-sedge peat for industrial purposes is dependent on several factors, among which are the establishment of manufacturing units of large capacity close to regional centers of consumption and the supply of suitable grades of peat at prices proportionately low in terms of both production and transportation costs. With the exception of strongly alkaline reacting material, several grades have been profitably employed as domestic peat products: they are used in the preparation of composts with waste from animal and other sources, as a filler for tankage and mixed mineral fertilizers, and as a source of organic matter for improving the structural condition and water-holding capacity of mineral soils.[4]

Moss Peat Soils

A layer composed of the small stems and leaves of sphagnum mosses is characteristically spongy fibrous, light yellow to reddish brown in color, and strongly acid in reaction. The amount of mineral salts and nitrogen is low in this type of peat; its absorbing capacity for water is high owing to the anatomical structure of the elongated capillary cells; and it supports only a small population of fungi and bacteria. Consequently the decomposition of moss peat is slow unless the acid reaction is corrected by the use of lime, its nutrient deficiency remedied by an application of a complete commercial fertilizer, and the activity of beneficial soil microörganisms established by means of stable manure. In both chemical and physical characteristics moss peat soils derived from flat and raised bogs or heaths are poor organic soils.[5]

Moss peat under cultivation requires deep fall plowing, disking and freezing, frequent packing by heavy rollers, and drainage with

[4] See A. P. Dachnowski: Preparation of Peat Composts, *U. S. Dept. of Agric. Dept. Circular 252*, 1922. The improvement obtained in mineral soils and the more noteworthy data of a physical and chemical nature are given in *Circular 290* of this Department (A. P. Dachnowski-Stokes: Grades of Peat and Muck for Soil Improvement, 1933).

[5] Most of the deposits of moss peat in Europe show a stratification into a light-colored upper (younger) and a dark-colored, more decomposed lower (older) layer of moss peat. These are separated by a woody layer (*Grenshorizont*) composed of material from ericaceous shrubs and from conifers and corresponding to the surface vegetation of the present time. This has given rise to the theory that changes in climate have taken place within geologically recent time (Cycles in Peat Deposits, in The Second Conference on Cycles, *Geogr. Rev.*, Vol. 19, 1929, pp. 301–303).

a well controlled water level to maintain good tilth. Grasses for hay and pasture or potatoes, as a first crop, and corn, preferably for silage purposes, are known to be profitable in the preparation of this type of peat for other farming practices. Moss peat that has undergone a moderate degree of decomposition is brown in color, contains an appreciable amount of dark-colored residue, small woody fragments, and fiber from cotton grass more resistant to decomposition than the material derived from mosses. Hay-and-stock farming is the more profitable form of agriculture utilizing this type of peat land.

The suitability of moss peat for commercial use depends on the quality and thickness of a workable layer.[6] A good grade of fibrous and poorly decomposed sphagnum-moss peat serves various purposes if properly air dried, shredded by simple tearing machinery, and passed through sieves. Coarse, lumpy pieces are used for stable bedding, poultry litter, and for packing, insulating, deodorizing, and composting. The finely shredded material is more satisfactory for soil improvement, as a surface mulch for evergreen trees, shrubs, and many herbaceous perennials, and for horticultural uses in greenhouses.

Woody Peat Soils

The important soil feature of a woody layer of peat is the large amount of material that has developed almost wholly under the cover of trees, shrubs, and their related undergrowth. It varies quite as much from the effects of different climatic conditions as from underlying mineral soils and from regional changes in the dominant vegetation of swamp forests such as spruce, cedar, and tamarack, maple, ash, and elm, or cypress, gum, and white and red bays.

A layer of woody peat is generally a mixture of organic material: it consists usually of litter from leaves and needles and from fallen logs, stumps, branches, and twigs varying in size and degree of decomposition; there are present also an appreciable amount of woody roots and of crumbly and granular residue and a variety of microörganisms, including wood-destroying fungi.

Coniferous woody peat, derived from evergreen trees and shrubs, has a marked acid reaction and is correspondingly coarse, raw, and poor in mineral nutrients and basic constituents. The organic material is of low value for agricultural purposes even several years after clearing. It is, therefore, of the greatest importance to retain for natural reproduction the forests already on such areas and gradually to clear away the poor growth of timber by successive thinnings or to improve it by cuttings. With careful selection and partial drainage a natural wood lot may be conserved that would supply the needs

[6] A. P. Dachnowski-Stokes: Moss Peat, Its Uses and Distribution in the United States, *U. S. Dept. of Agric. Circular No. 167*, 1931. Its use for soil improvement has been noted in *Circular No. 290* (see footnote 4).

for rough timber, poles, fence posts, fuel, and raw material for local industries.

Woody peat soil that has developed under hardwood forests is darker in color, slightly acid to alkaline in reaction, and friable, with a pronounced granular structure. The granular residue is of fine texture and in better aerated condition; it forms a larger proportion and extends to a greater depth in the layer and is generally designated as muck.

Woody material of this kind requires expense and labor in clearing, but it is usually peat land of better productive power than that supporting evergreens and conifers. Brush may be cleared at comparatively low cost by means of tractors. Satisfactory results are obtained from shallow cultivation the first year, gradually increasing the plowed depth from year to year. A crop of corn or pasture of clover and tame grasses is obtained on virgin peat land without incurring the expense of removing logs, stumps, and roots. Woody peats that have long been cultivated and fertilized are used almost exclusively for the production of vegetables. Because of the presence of coarse woody pieces and the practical difficulty of separating the variable quantity of granular residue, the woody peats do not constitute good organic material for commercial or industrial purposes.

SOUTHERN PATAGONIA

AS PORTRAYED IN RECENT LITERATURE

William E. Rudolph

THIRTY years ago thousands of people who had rushed to the southern extremity of South America in search of gold turned to sheep raising as a more certain means of making a living. Today we perceive a tendency toward reversal of this trend. Not that new gold deposits have been found in this region—actually we know little more about them—but the world itself has changed—a world that finds itself today with plenty of sheep and a shortage of the gold necessary to distribute those sheep, a world that needs gold far more than it needs mutton or wool or any other commodity. Indications are not wanting that this forgotten region is upon the threshold of return to public interest.

Of all the regions of the earth's temperate zones it is doubtful whether there remains a single one of which man's knowledge is so incomplete as of that of the southern Patagonian Andes from the forty-fifth parallel of latitude to the outermost islands of the Tierra del Fuego archipelago. Yet we can hardly call this land of mystery remote: not one of its 180,000 odd square miles of mainland and islands is 200 miles distant from one of the New World's oldest trade routes. Nor has there been a dearth of interest in it. Between Magellan's discovery of the strait in 1520 and the visit of the *Beagle* in 1832 no fewer than 81 expeditions representing many nations have explored there. Between the voyage of the *Beagle* and the publication of "Charles Darwin's Diary of the Voyage of H. M. S. 'Beagle' " last year[1] scores of books and articles in various languages have appeared. Yet one needs only to glance over the most recent literature to realize how little is actually known, and even the latest maps disclose vast areas marked "inexplorado." But, while the region has fallen into further economic obscurity with the replacement of the Strait of Magellan as a maritime channel by the Panama Canal, a new impetus seems to have been given to scientific exploration. To mention one event of importance: the most extensive of Patagonia's great inland ice fields was traversed for the first time by De Agostini in 1931—truly a noteworthy achievement. We may well begin our discussion with the problem of the present glaciation of Patagonia.

The Inland Ice Fields

The permanent ice fields of southern Patagonia are the largest glacial areas found within the temperate zones. At their northern

[1] See review elsewhere in this number of the *Geographical Review*.

limit, near the Río Aysen, these fields begin at about the 2000-meter level; in Tierra del Fuego they extend upward from 750–900 meters. Only a few crests and rocky points rise above these rugged white masses, which attain 30 kilometers and more in width. In the distance of 1200 kilometers from its beginning south of the Río Aysen to its termination with the Cordillera Darwin in Tierra del Fuego this ice mantle loses its continuity at but two localities—at Baker Canal and around the Strait of Magellan. Thus it is subdivided into three principal ice areas, of which the central is the most extensive. Ribbons of ice extend to the sea on the west hand and to the Andean lakes on the east. It is at latitude 46° 40′ S. that the northernmost of these glaciers, San Rafael, reaches the sea—10 full degrees more distant from the pole than the southernmost glacier of Alaska, more than 20 full degrees farther than Jökelfiord (68° N.), the southernmost glacier of Norway reaching the sea.

Despite the difference in latitude, the Patagonian ice fields are far more extensive than those of Scandinavia, and Feruglio describes them as differing radically from these because of the more rugged Andean relief buried beneath, which makes them comparable rather to the Alps during the glacial epoch.[2]

It was for this reason that De Agostini was unable to use his sleds in traversing the central ice field during 1931.[3] In recent years this inland ice has been designated the "Patagonic type of glaciation" because of inherent characteristics that distinguish it not alone from the Scandinavian and Alpine types but from the Greenlandic and Alaskan types as well.[4] At the present time the eastern front of the inland ice appears to be in retrogression. Feruglio points to morainic masses at Lago Argentino and to the front and sides of the Upsala Glacier, from which the ice retired only a few decades ago, judging from the scant vegetation as compared with the well developed forests just beyond. De Agostini found moraines 140 meters in height. However, this is an exceptional case, for in most of the eastern glaciers retrogression is far less accentuated, as is evidenced by the woods that almost encroach upon their borders. In Tierra del Fuego the Negri Glacier is described by De Agostini as showing recent progressive retirement by the clearly defined frontal moraine formed of immense blocks of granite 100 meters distant from its present termination. Cataracts of ice observed upon the eastern fronts also signify that retreat is in progress. Upon

[2] Egidio Feruglio: La glaciazione attuale, le fasi glaciali quaternarie e i loro rapporti coi terrazzi marini nella Patagonia, *Boll. Comitato Glaciol. Italiano*, No. 13, 1933, pp. 59–90 *idem:* Informe preliminar sobre los resultados científicos de la expedición A. de Agostini al Lago Argentino (Patagonia), *Gaea*, Vol. 4, 1932, pp. 116–131.

[3] A. M. De Agostini: Mi primera expedición al interior de la Cordillera patagónica meridional verano de 1930–1931, *Solar*, Museo Antropológico y Etnográfico de la Facultad de Filosofía y Letras, Buenos Aires, 1931, pp. 41–64.

[4] Fritz Reichert: Regiones andinas inexploradas de la Patagonia Austral entre el Lago Argentino y el Fiord de San Andrés, *in* Patagonia: resultados de las expediciones realizadas en 1910 a 1916, Sociedad Científica Alemana, Buenos Aires, 1917, pp. 95–135; reference on p. 129.

FIG. 1—Map of southern Patagonia. Numbers have reference: 1, international boundary (note the three triangular strips of undefined territory north of Mts. FitzRoy, Murallon, and Stokes respectively); 2, watershed divide (wide spacing of dots where divide is coincident with the political boundary); 3, eastern limit of terminal moraines; 4, boundary between geological formations of cordillera and pampa; 5, De Agostini's route across the inland ice; 6, inland ice fields. Scale of map approximately 1 : 9,500,000.

the western slopes, characterized by greater precipitation, the glaciers are in a state of advance.

De Agostini points to five factors rendering possible the survival of ice fields at this latitude: abundance of precipitation, cloudiness,

low summer temperature, elevation above limit of perennial snow, and orographic configuration.[5] As we have said, he was the first man to cross this vast unknown, leading an expedition over the central ice area from Lago Argentino to Falcon Fiord during the summer of 1931. Members of the Chile-Argentina boundary commission, a third of a century earlier, had been content to traverse the margins of the cordillera in determining the *divortium aquarium* between the two nations. Otto Nordenskjöld attempted to cross from Lago Dickson to Seno Peel in 1895; Moreno turned back at the cordillera summit west of Lago Argentino in 1914; while Witte, Kühn, and Kolliger reached the ice divide west of Lago Viedma in 1916. De Agostini set out from the northern bay of Lago Argentino on January 24, 1931. He crossed the Upsala Glacier and proceeded westward through a pass in the Andean chain. Here he discovered, stretching northward with gentle slope toward the Pacific, an icebound plateau, which he named Altipiano Italia. His barometer recorded 1940 meters, with temperature of −1.5° C. (10.30 a. m. in midsummer). Continuing northwestward in a diagonal line across this plateau for some 25 kilometers, he climbed Mt. Torino, where, from an altitude of 2252 meters, he viewed an inlet of the sea about 5 kilometers away and recognized Falcon Fiord, which he had visited on a previous trip. Here the temperature was −2.5° C. Returning, he reached his starting point on February 13.

The northern ice field was visited in 1920 by Otto Nordenskjöld, who penetrated it from the west for a short distance. To move his party from the shores of Kelly Inlet, off the Gulf of Peñas, where he landed, to the ice of the San Tadeo Glacier, about 5 kilometers distant in a straight line, required 12 days' unceasing work, with 3 intermediate camps. From observation points in this neighborhood he viewed and mapped portions of the northern ice field, which stretched eastward for a width of about 30 kilometers to the Andean backbone range.[6]

Some interesting comparisons are to be drawn from De Agostini's and Pallin's descriptions of the central and northern ice fields, the one approached from the east, the other from the west. Each describes broad ice fields to the west of the cordillera: "gently sloping toward the Pacific," says De Agostini of the central ice field; "almost concave," says Pallin of the northern ice field. Each noted lower peaks near the coast forming the western barrier that confines the ice.

The southern area of inland ice, extending for a distance of 130 kilometers from west to east across the southern part of Tierra del Fuego, is a group of small ice fields rather than a continuous mantle. Actually we know little of the Tierra del Fuego cordilleras; they have

[5] A. M. De Agostini: La prima traversata della Cordigliera Patagonica dal lago Argentino al fiordo Falcon, *Le Vie d'Italia e del Mondo*, Vol. 1, 1933, pp. 589–606.

[6] H. N. Pallin: Mountains and Glaciers in West Patagonia, *Alpine Journ.*, No. 246, Vol. 45, 1933, pp. 62–79.

been but slightly explored despite their comparatively low altitude (mean elevation 1500 meters, with Mt. Darwin, 2300 meters, the highest peak). De Agostini was able to examine the largest field in this area during ascents of peaks in the Mt. Sarmiento region, which he described as an ice-and-snow mantle completely covering an *altiplano*, with festoon-like glaciers descending the rocky slopes—indicating an ice cap not dissimilar to those of the Patagonian mainland. The more easterly portions of this range were examined from the air late in 1928 by the German aviator Gunther Plüschow,[7] who described sharply outlined peaks and ranges from whose flanks immense glaciers descended upon all sides, uniting, separating, some reaching here and there to the sea, others terminating within the land area. The most interesting result of his observations was the discovery of the large number of small lakes within the Darwin cordillera, thus disproving statements of writers and designations upon maps that a continuous mantle of inland ice exists here.

While the glaciers of southern Patagonia's western slope remain for the most part unknown, many of those of the eastern slope have been explored in recent years. De Agostini describes the Upsala Glacier[8] as the greatest of the eastern slope, with a length from the edge of the central ice field to its outlet in Lago Argentino of not less than 50 kilometers and a width ranging from 9 to 12 kilometers. As many as seven tributary glaciers feed it. To the Viedma Glacier, which descends to the western shores of Lago Viedma, he awards second place.[9] Each glacier terminates in a small glacial lake dotted with floating ice, at the end of which stands a low barrier of glacial detritus through which the drainage cuts to enter a bay of the main lake. With thunderous discharge huge blocks break off from a vertical wall of ice 20 meters and more in height and generally more than a kilometer in periphery.

Glaciation of the Past

It is apparent that these present ice fields are merely the modest remains of the vast ice cover that once extended southward of the Gulf of Reloncavi over areas now represented by the Patagonian and Fuegian archipelagoes. Viewing any of the valleys of the cordilleran zone, widened and deepened by glacial excavation, and the great moraines in a series of horseshoe-shaped amphitheaters to the east, we realize that ice has been the principal morphological factor throughout the greater part of southern Patagonia.

The latest investigators agree that the series of morainic deposits

[7] Gunther Plüschow: Silberkondor über Feuerland, Berlin, 1929.

[8] Prima spedizione nella Cordigliera Patagonica meridionale (estate 1930–1931). *Boll. Reale Soc. Geogr. Italiana*, Ser. 6, Vol. 8, 1931, pp. 803–813.

[9] Seconda spedizione nella Cordigliera Patagonica meridionale (estate australe 1931–1932). *Boll. Reale Soc. Geogr. Ital.*, Ser. 6, Vol. 9, 1932, pp. 723–730.

indicate four glacial invasions, with the earliest the most extensive.[10] Feruglio, who accompanied Father De Agostini on his last expedition, lists and dates these glacial-drift formations as follows:

To the Postglacial: (1) moraines at sides and fronts of existing glaciers, signifying retrogression in progress; (2) moraines situated 2 to 6 kilometers from actual fronts of present glaciers, due to pause in fourth glacial recession; (3) moraines situated 21 to 25 kilometers from present glaciers (in Lago Argentino region), due to earlier pause in fourth glacial recession.

To the Pleistocene: (4) terminal moraines of the fourth glacial invasion; (5) terminal moraines of the third glacial invasion; (6) terminal moraines of the second glacial invasion; (7) terminal moraines of the first glacial invasion, bounding the outside of the amphitheaters. Caldenius claims to have found all four of the morainal systems in the principal transverse valleys.[11]

Remains of moraines in a poor state of preservation and identified with the first glacial advance that are found on the Atlantic seaboard as far north as the mouth of the Río Gallegos are probably the northern limit of the glacier that excavated the eastern part of the Strait of Magellan. The moraines near Cape Virgenes are attributed by Caldenius to the second advance of this glacier, while the first and second narrows correspond to the third and fourth invasions. The remarkable state of preservation of the horseshoe-shaped morainal amphitheaters, on the other hand, is apt to be misleading as a determining factor of their age. Rather is this due, states Feruglio, to the arid, windy climate, which has rendered processes of destruction by water slow.

The *barrancas* and isles of the Strait of Magellan, composed of glacilacustral deposits, indicate that here were glacial lakes impounded by terminal moraines to levels well above sea level, with the first and second narrows the early outlets of these lakes.

The work of the glaciers is not shown in their morainal deposits alone. Fester[12] observed north and south of the Prat group of hills, north of the bay of Ultima Esperanza, parallel hills of bare rock, resembling a field scored by a giant plow.

After each glacial advance the glacial lakes were regenerated between the border of the receding glacier on the west and the morainal barrier on the east. Each time their eastern shores were located farther toward the west; doubtless the bays at their western extremities were driven more deeply into the cordillera. During the earlier inva-

[10] C. C. Caldenius: Från en treårig geokronologisk forskningsresa i Patagonien, *Ymer*, Vol. 51, 1931, pp. 1–24; Guido Bonarelli: Geología de América Meridional, *Revista Minera*, Vol. 4, Buenos Aires, 1932, pp. 51–57; Feruglio, La glaciazione attuale.

[11] Las glaciaciones cuaternarias en la Patagonia y Tierra del Fuego y sus relaciones con las glaciaciones del hemisferio boreal: estudio geocronológico, *Anal. Soc. Científica Argentina*, Vol. 113, 1932, pp. 49–70.

[12] G. A. Fester: Algunas obeervaciones de un viaje a la Patagonia, *Revista Minera*, Vol. 3, 1931, pp. 82–89 and 125–126; reference on p. 89.

sions no important changes were made in the drainage of the eastern Andean slopes through old valleys to the Atlantic. During the later invasions lakes Buenos Aires, Pueyrredón, San Martin, and Sarmiento, together with many smaller lakes, reversed their drainage to enter the Pacific, leaving the valleys of the rivers Deseado, Chico, Shehuen, and others practically dry. Lakes Viedma and Argentino alone of the larger bodies remain in the Atlantic watershed, although even Viedma had its drainage deflected from the Río Shehuen (to the east) to the Río Santa Cruz (to the south). Quensel treated this reversal of drainage in considerable detail as far back as 1910.[13] We cannot however agree with his explanation that Viedma and Argentino are today being held back from Pacificward drainage by ice masses.

These lakes appear to have broken through or pushed ahead the last morainal barrier to the east and thus to have fallen to a lower level before the ice barrier to the west had melted sufficiently to allow egress in that direction, as in the case of the other lakes. For Caldenius has observed that at these two Atlantic-draining lakes the fourth system of moraines now disappears below water near the center of the lake and that it is the third morainal system that now impounds the water on the east. The lakes have fallen to only about 200 meters' elevation. That there could now be passes below the ice cap at elevations as low as this through which Viedma and Argentino could still drain westward seems quite unlikely. Erosion of the present outlets of lakes Buenos Aires, Pueyrredón, and San Martin to Baker Canal we consider was begun with these lakes at much higher levels than at present.

It is evident from our discussion of reversal of drainage of the subandean lakes that the continental watershed divide no longer coincides with the principal crest of the Andean cordillera. Except in the region of lakes Viedma and Argentino, this has been shifted some one hundred kilometers eastward, to follow a more or less uncertain course along the ridges of the glacial deposits. Only between the peaks FitzRoy and Stokes does it coincide with the ice divide, which remains, as during the glacial period, at the crest of the cordillera.

Pampa and Cordillera

Upon the map (Fig. 1) there is a line dividing the cordilleran rock formations from those of the pampa. It is not a border line of geological formations only. It divides a region of rugged topography, of elevated mountains with steep slopes, from one of softly undulating plains with only weak morainal rises. It separates conditions of continuous wet weather, constantly clouded sky, and narrow range of temperature from those of dry atmosphere, clear sky, and wider swing

[13] P. D. Quensel: On the Influence of the Ice Age on the Continental Watershed of Patagonia. *Bull. Geol. Instn. Univ. of Upsala*, No. 17–18, Vol. 9, 1908–1909, Upsala, 1910, pp. 60–92.

of temperature. It divides virgin forest from pampas grass; unproductive soil, swampy and peaty, from soil adaptable to pasturing; a region still almost uninhabited from one that has made some small progress in settlement.

Kranck has divided the highland regions into three natural groups, as follows:[14] (1) Pre-Cordillera (Cretaceous sediments), the outpost hills to the east and, in Tierra del Fuego, to the north of the main range; (2) Central Cordillera, the backbone range of the Andes (metamorphic schists of Paleozoic age, quartz porphyries, cordilleran granites); (3) Coast Cordillera, occupying mainly large islands along the Pacific coast (batholiths of Andean diorites). Adding the pampa (Tertiary sediments, overlain in the west by a stratum of fluviglacial origin), we have four distinct zones in southern Patagonia.

Kranck dates the mountain building to the close of the Cretaceous or the beginning of the Tertiary. The Tertiary beds of the pampa, he states, have been nowhere influenced by cordilleran folding, as far as is known at present.[15] The slight folding they exhibit he ascribes to much later uplifts along the border of the mountain range.

After the orogenic movements of mountain making the continent appears to have been subjected to both depression and elevation. The configuration of the canals and fiords of the cordillera indicates that these are erosion valleys that have sunk below sea level. Kranck believes that they were first established during the folding of the cordillera and were finished during the late Tertiary, when the base of erosion was higher than at present. During the Pliocene and Pleistocene the land appears to have been lifted, probably in connection with earth movements in the more northerly parts of the Andes.[16]

Upward movements have continued to the present day.[17] Feruglio found five systems of coastal terraces along the Atlantic resulting from this emergence, which on the seaboard was greatest about Puerto Deseado: in the interior, judging from the depths to which the watercourses have cut, it was still greater. Of the coastal terraces the first, the most elevated (165–185 meters), was probably before the Quaternary, judging from its high percentage of fossils of extinct molluscan forms. Of particular interest are the third (35–60 meters) and fourth (15–30 meters) systems, with fossils of mollusks of temperate-warm climate in the former, of temperate-cold climate in the latter, the temperate-warm-climate fossils being of an interglacial phase, the tem-

[14] E. H. Kranck: Färder i den eldsländska Cordilleran (Intryck från Geografiska Sällskapets eldslandsexpedition 1928–29), *Terra*, Vol. 42, 1930, pp. 129–150.

[15] Geological Investigations in the Cordillera of Tierra del Fuego, *Acta Geographica 4*, No. 2. Helsingfors, 1932.

[16] This has been only imperfectly studied thus far, Kranck considers, and he awaits more detailed study of tectonic conditions of the cordillera north of the Strait of Magellan for comparison with investigations that he has been making in Tierra del Fuego.

[17] Feruglio, La glaciazione attuale; *idem:* Prospetto riassuntivo dei terrazzi marini della Patagonia, *Union Géogr. Internatl., Troisième Rapport de la Commission pour l'Étude des Terrasses Pliocènes et Pléistocènes*. Paris, [1933?], pp. 140–155.

perate-cold forms of a glacial phase—the last-glaciation period. Feruglio's fifth system (6–12 meters' altitude) contains fossils of species now living in the adjacent seas, which indicates a recent lowering of marine level. This checks Daly's theory of regional rising of land (lowering of sea level) about twenty feet during the past 3500 years, due to slight cooling and consequent greater extension of continental ice.

Some mention should be made of the two series of intrusive rocks of the cordillera—the granites of the Central Cordillera and the Andean diorites of the Coastal Cordillera. De Agostini found such a great preponderance of fragments of intrusives (quartziferous diorite) in glacial moraines near Lago Argentino that he concluded that the upper parts of mounts FitzRoy, Murallon, and other peaks of the Central Cordillera were batholiths of this material. Kranck refers to intrusives in the elevated parts of the Cordillera Darwin in Tierra del Fuego as granites of the Central Cordillera. Probably the two series are the same or quite similar. The batholith of the Coastal Cordillera is quite distinct. Its "Andean diorites" come from an almost continuous intrusion of granodiorites during folding and overthrusting of the southernmost part of the South American cordillera, Kranck tells us. Kranck's recent petrological investigations upon these rocks in Tierra del Fuego, as reported in the very detailed work covering his geological investigations, place them within the Pacific series of granodiorites—intrusives that extend throughout the entire length of Chile and in connection with which the great copper deposits of Chuquicamata and other ore bodies have been found.

The basaltic-lava deposits that cover the Patagonian *mesetas* or are intercalated among the sedimentaries—the glacial and fluvioglacial deposits alike—as well as remains of craters surrounded by volcanic materials (especially southwest of Gallegos) indicate that southern Patagonia was subject to volcanism during the Tertiary and the Quaternary. Feruglio finds that this reached a maximum in the *altiplano* zone of southern Patagonia and that in its latest phases such activity was displaced from the subandean region and the eastern slopes of the cordillera to the west. Although volcanic disturbances occur to the present day some five hundred kilometers north of the Río Aysen, the few existing volcanoes in southern Patagonia are dormant. Feruglio recently discovered a volcanic cone with crater still intact within the morainal amphitheater surrounding Lago Buenos Aires,[18] with vast basaltic-lava extrusions covering the glacial and fluviglacial deposits. Near by were other basaltic lavas, apparently from other eruptive centers, which had descended almost to the

[18] Egidio Feruglio: Osservazioni intorno all'anfiteatro morenico del Lago Buenos Aires (Patagonia) e a un cono vulcanico su di esso inserito, *Boll. Reale Soc. Geogr. Italiana*, Ser. 6, Vol. 10, 1933, pp. 246–255.

bottom of the valley of the Río Pintura, indicating quite recent volcanic activity.

Volcanic formations have caused the existence of Lago Cardiel, described by Steffen[19] as the largest (470 square kilometers) interior drainage of the Patagonia *meseta* region. Although its present level (318 meters) is considerably higher than that of the subandean glacial lakes, it has in recent geological times fallen below the dry watercourse to the east, which once discharged its flow to the Río Chico.

The Wind and the Rain

The west of the cordillera in Patagonia is well known as one of the wettest regions of the earth's surface. Rainfall is nowhere less than 1000 millimeters; it reaches over 5000 millimeters at Bahía Félix on Isla Desolación and in all probability is even higher along the western slopes close to the crest of the cordillera. To the east of the main cordillera precipitation decreases regularly and rapidly. At our line dividing the cordillera and pampa zones it is about 400 millimeters. East and north of this line the climate is dry, with less than 200 millimeters about the Golfo de San Jorge.[20]

In the western and southern regions rain is more or less continuous throughout the year. Admiral Spiess[21] writes of the Cockburn Canal that it has but a single day in a hundred of calm, sunshine, and only occasional precipitation, while of Staten Island it has been written that 24 continuous hours without rain, sleet, or snow are unknown. In the pampa, on the contrary, there are pronounced dry seasons. Fester[22] notes that maximum precipitation occurs in summer and fall at Magallanes, Harberton, and Río Gallegos, in fall and spring at Cape Virgenes, and in summer and spring at Ushuaia, with relative dryness during the winter at all these places, which, by curtailing the amount of winter snowfall, is a favorable factor for sheep raising.

Patagonia is also known for its "trenchant wind."[23] The tip of the continent is marked by a conflict of ocean currents, the cold westerly drift dividing at Cape Horn into northward and eastward-flowing branches, while a branch of the warm current from Brazil impinges seasonally upon the Atlantic littoral. Turbulent wind conditions result—not alone the normal high winds due to an abnormally low average barometer[24] but storms that arise suddenly and rage

[19] Hans Steffen: Grenzprobleme und Forschungsreisen in Patagonien, Stuttgart, 1929.

[20] See the series of maps (rainfall, climate, vegetation, livestock, population) in Wellington D. Jones's contribution on Patagonia in "Pioneer Settlement," *Amer. Geogr. Soc. Special Publ. No. 14*, 1932, pp. 124–145.

[21] F. Spiess: Durch die Kanäle des Feuerlandes, *Meereskunde No. 206* (Vol. 18, 1932, No. 10).

[22] Wirtschaftsgeographie Südpatagoniens (Territorio de Magallanes), *Petermanns Mitt.*, Vol. 79, 1933, pp. 9–13 and 73–77.

[23] K. E. Barrett: The Trenchant Wind, Cambridge [England], 1932.

[24] 751.3 millimeters at Magallanes, latitude 53° 10′ S., and decreasing 1 millimeter a degree of latitude for some distance southward, whereas mean reduced to sea level at latitude 40° in Argentina is 760 millimeters.

for a week or an entire month. In the lake region strong winds are quite common. Fester mentions a waterfall near Cerro Tenerife, fed during afternoons from melting snows, which became dry during a windstorm that completely swept away the water from the crags above. It was such an erratic wind that caused the death of the German aviator Gunther Plüschow on Lago Argentino in 1931, cutting short a promising career that bade fair to add much to our knowledge of these regions. These winds will undoubtedly interfere with the mapping and exploration of southern Patagonia by the modern aviation methods that have been used in other remote regions.

Stormy Seas

Among the earth's most turbulent waters are the seas of this region. The complicated currents set up in these labyrinths of canals by the ebb and flow of tides having considerable range were compared by Darwin to movements in a tub of boiling water, and the remains of vessels found along these rocky channels tell their own story. Diurnal tidal ranges here are equaled at but few coasts, that at Puerto Gallegos, 45.6 feet (nearly 15 meters), being the greatest of all the world's tides listed by Bauer.[25]

At the eastern entrance to the Strait of Magellan tidal currents from the southeast enter with full force, with 13½ meters' range at spring tide. These waves reach the first narrows with a speed up to 13 kilometers an hour and with 11 meters' range. At the bay between the narrows spring tidal range has fallen to 6 meters, at the second narrows to 2½ meters. Here the flood waters are spread out in canals Nuevo and Famine, and at Magallanes spring tide, occurring 4 hours after high tide at Cape Virgenes, has a range of only 1.8 meters. At many of the channels tidal movements are even more intricate. The height of the waves in these regions is also noteworthy, reaching 15 meters and more at Cape Horn. Employees of the lighthouse at one of the Islas Evangelistas, at the western entrance to the strait, found it necessary to build rampart walls to protect their water supply, at 56 meters height, from salt-water spray.

Bush and Forest

We have the sharp line of division again between the plant zones in southern Patagonia. The border between pampa vegetation and the forest approximates the eastern limit of the cordilleran-formations line shown upon the map. The plains of eastern Patagonia and of northern Tierra del Fuego are covered with short bunch grass and xerophytic bush. To the west lie the forest zone of deciduous beeches (*Nothofagus antarctica* on the lower slopes and *Nothofagus pumilio*

[25] H. A. Bauer: A World Map of Tides, *Geogr. Rev.*, Vol. 23, 1933, pp. 259–270.

on the slopes above 300 meters) and, finally, the moist zone of evergreen beeches (*Nothofagus betuloides*). Between is a narrow transition belt of underbrush, where the pampa invades the forest at one point and vice versa at another. Fester describes extensions of the woods eastward of the cordillera in sheltered valleys and upon lower mountain slopes of the Ultima Esperanza district, while at no great distance the pampa reaches westward to Consuelo Bay, a fiord of the Pacific. Sharp indeed is the contrast between the evergreen and the leaf-bearing beeches: almost in a moment the traveler passes from the dense, damp, luxuriant foliage of the well-nigh impenetrable evergreen forest to the bright open landscape of the unobstructed deciduous forest.

The tree line reaches only 350 meters in parts of Tierra del Fuego;[26] it is all of a thousand meters higher in the region of the Río Aysen. Above the tree line is a narrow belt of dwarf woods, extremely difficult of passage. As seen in his crossing of the Tierra del Fuego cordillera De Agostini describes it as composed of trees of the *Nothofagus pumilio* a meter or more in height, with branches of the lower trunk nearly horizontal and those of the upper so affected by wind action as to resemble a hedge trimmed with scissors. The width of this zone depends largely upon the degree of dampness of the soil and the protection from winds, which not only dry out the soil but also prevent humus formation and sweep away the seed. Between the scrub-growth girdle and the snow line lies the alpine meadow—almost a desert waste. Here, to about 1200 meters, Fester found plants of the Senecio family growing. In general it might be said that the forests reach a higher line on the eastern (and in Tierra del Fuego on the northern) slopes, for here the drier climate makes for a correspondingly higher elevation of the snow line (some 200 meters higher in Tierra del Fuego).

A point of special interest is the formation of peat bogs, particularly numerous in the outer western islands. Here the superabundance of snow and rain, coupled with exposure to strong winds, has fostered the growth of moss-like plants and hindered forest formation. Many of the valley bottoms have been converted to peat bogs: such formations amount to fully 2 per cent of the surface of Argentine territory on Tierra del Fuego and Staten Island. Swamp growth of this type continues to invade flat lower slopes and valleys to the present day.

The query has been raised as to where the flora of the southern Patagonian forests was preserved during the ice invasions.[27] The drier-zone species might have spread to the north and east to regions that the ice did not reach. But for the species of the superhumid

[26] Th. Herzog: Baum- (Wald-) und Schneegrenzen in den Kordilleren von Südamerika, *Mitt. Geogr. Gesell. zu Jena*, Vol. 39, 1931, pp. 72–89.

[27] C. Skottsberg: Zur Pflanzengeographie Patagoniens, *Berichte Deutsch. Botan. Gesell.*, Vol. 49, 1931, pp. 481–493.

southern forests the explanation is more difficult, as this region is believed to have been completely ice-covered. Skottsberg suggests that perhaps in southwestern Patagonia there were ice-free coast regions similar to certain areas in Norway during the glacial invasions. If not, the only remaining solution is that the plants found asylum on the island of Chiloé, which was not fully ice-covered, although no traces of these species are found upon Chiloé today.

Natural Resources

Thousands of settlers have been making a fair living from sheep raising and subsidiary occupations in southern Patagonia, despite the serious obstacles of climate. Theirs has been no easy task. As recently as 1930, Fester tells us, fully half of the stock in the Argentine territory of Santa Cruz was lost on account of heavy snows. Losses were heaviest where land division had left certain ranges with only high-lying *mesetas* and no protected *cañadones* in which the sheep could find shelter. Farming is hindered by late frosts and abnormal winds. Fester mentions a complete fruit crop near Lago Toro (approximately latitude 51° 15′) destroyed by frost during the budding period—a by no means uncommon occurrence. Wind acts as an even more damaging factor, not only through its mechanical effects but also through its indirect action in raising the evaporation rate. Only a small part of the land may be utilized for agriculture because of lack of water on the flat plains on the one hand, of rugged topography where rainfall is plentiful, on the other. In the southwest canal region wind prevents cultivation on the steeper slopes, and where wide flat girdles or valleys do exist, as on Isla Santa Inez, Navarino, and southeast Tierra del Fuego, possibilities are lessened by swamp growth. Despite this, the world's southernmost farm land is found upon Navarino: this island, though mountainous and heavily wooded, supports a number of small *estancias* with thousands of sheep along the northern coast. De Agostini notes that Navarino is the only island of the southern archipelagoes, except Tierra del Fuego, where guanacos live, and he has found during extensive travels in this region that wherever the guanaco lives life is tolerable for human beings, as regards not only climate but also productivity of soil.

Of all the lands in southern Patagonia only the subandean transition zone qualifies for farming operations of any importance. Even here wind acts as a serious retardant, particularly where glacial excavation has produced low valleys through which the west winds can sweep uninterrupted, as in the Ultima Esperanza region. Sheep ranches also extend into this zone, and are gradually pushing upward on the slopes to the upper woods limit. Beyond this level penetration into the dwarf-woods zone is not practicable, if only because of the difficul-

ties of destroying the growth by fire. Peculiarly enough, as Fester points out, Chilote Indians have to be imported to provide labor for the sheep industry.

Where the woods encroach upon the pampa zone the trees are burned and seeds of pasture grasses planted. There is no great use for the lumber because of the abundant supply available from south-central Chile. Some lumbering, using mainly the *Nothofagus pumilio*, is done in the Natales region to meet the needs of local building, and there is an exportation of firewood, for which the harder, more crooked *Nothofagus antarctica* is used, to eastern Patagonian ports.

The metal resources of southern Patagonia have been of no great importance thus far. Until recently gold washing had been carried on only on a small scale. The brown-coal mines of Mina Loreta and also of Mina Elena (on Isla Riesco) have been producing about 60,000 tons yearly, used for local industry and shipping. Extraction of peat, also for local use, is carried on in eastern Tierra del Fuego on a small scale. Marble quarries have been opened on Isla Diego de Almagro.

It is doubtful whether any other region of the earth's surface can vie with these southernmost Andes for scenic beauty. We borrow De Agostini's phrases from the Italian: "amid the bleakness and mournfulness of the heavens, and the furious tempest of the sea, the imposing and mysterious greatness of the mountains, a fusion of lines, lights, and colors." But it is not for these regions to assume commercial importance as a future Mecca for tourists. Nature has barricaded them too well.

The International Frontier

Cutting through the region generally from north to south is the crooked line dividing Argentina from Chile, laid out by the boundary commission of King Edward VII in 1902 to end the serious dispute between the two nations. Until the fifty-second parallel is reached this frontier approximates the continental water divide, except at lakes Buenos Aires, Pueyrredón, and San Martin, each of which is crossed near its center. From latitude 52° S. there are geometric lines eastward to Cape Virgenes and southward along meridian 68° 36′ 38″ W. to the Beagle Canal. The English commission extended their line sufficiently eastward through the Beagle Canal to award the island of Navarino to Chile but made no disposition of three much smaller islands to the east—Picton, Nueva, and Lennox. Both countries still claim these islands, and although auriferous sands were washed along the beaches of Lennox and Nueva some forty-five years ago the question of ownership does not appear to be bothering either country.

Fester makes the point that the geometric boundaries north and east of the strait do not follow the "culture boundary," which appears

upon our map as the border between the pampa and cordillera formations. Argentine products must cross the frontier to reach their natural outlet at Magallanes; Chilean products cross into Argentina to their outlet at Puerto Gallegos. The road connecting the Chilean ports of Magallanes and Natales (Ultima Esperanza district) passes through Argentine territory for a short distance. Again, Chilean settlements along the Beagle Canal and on Navarino are close to the Argentine port Ushuaia but have contact with Chilean Magallanes only by occasional steamers. However, it can be clearly seen that no frontier leaving the Strait of Magellan in Chilean possession (theirs since 1843) could have been laid out at this section without causing some inconvenience. So little known are parts of this frontier region that the official Chilean and Argentine government maps do not agree as to exactly where the line lies. The Isla Wellington-Lago Argentino sheet of the American Geographical Society's Millionth Map of Hispanic America, published in 1928, shows three such sections—narrow, triangular strips reaching 10 kilometers in width—at which boundary claims overlap or where the territory is claimed by neither country (Fig. 1).

Mapping and Place Names

Most of the mountainous zone of the interior of Tierra del Fuego remains unexplored, although its principal mountain chains and peaks, by virtue of their closeness to the coast, have been charted and have served as navigators' landmarks for many years. The same applies to the greater part of the cordilleran zone from the Taytao Peninsula to the Bay of Ultima Esperanza, and to many of the adjacent islands. Some regions of the glacial moraines, though generally at lower elevations than the cordillera and lacking permanent snow, are still designated as "inexplorado." De Agostini and Kranck mention the presence of many lakes and marshes here that have not been explored. There are serious disagreements between the Chilean and Argentine government maps, not only in mapping but also as to the application of certain place names. Admiral Spiess tells of the *Dresden* seeking refuge within the intricate network of canals and bays of the Strait region after the Battle of the Falkland Islands and discovering new channels where land was shown upon the maps—discoveries recorded on the German sea charts by such names as Dresdenföhrde, Dresdenhort, Weihnachtsbucht.

Names of many nationalities are represented on the maps of southern Patagonia, but of aboriginal names there are few. Caldenius remonstrates that the ancient name, Cami, of the long, narrow lake in southern Tierra del Fuego should not have been changed upon the maps to Fagnano, Cami being one of few geographical names that remain to preserve the traditions of the Onas. De Agostini, on the

other hand, feels that the name Fagnano should remain, in token of the great good that Father Fagnano accomplished as a missionary. We agree that Father Fagnano well merits whatever small tribute may have been paid him in acknowledgment of years spent in danger and privation in behalf of these unfortunate people. Yet we wish that his name might have been applied to some other important geographical feature, some place that had no older name. We question the right of any explorer to change place names long in use. For us of the present generation the change may have but little significance, but for students of the future it may mean permanent loss of a connecting link important to archeological research.

The Natives

Truly primitive were the people found by the white man in this southernmost inhabited region of the earth's surface. Certain of these Indians "afford a clue as to the state of the first men to attain the shores of the Western Hemisphere," writes Lothrop,[28] and his surveys of vast midden heaps of mussel shells indicate that the southern coast of Tierra del Fuego has been occupied for 2000 years at least. Yet these Indian tribes, who so long withstood the rigors of climate and the difficulties of securing food, have succumbed in less than a century to contact with the white race. Seventy-five years ago there were probably more than three thousand representatives of each of the three island races—Yahgans, Alacalufs, and Onas; in 1880 seven to eight thousand of these Indians were counted by missionaries; today scarcely half a thousand survive. A few years hence, perhaps, there will remain only the monument "al Indio" on the plaza of Ushuaia, erected by the race that caused his extinction.

The Yahgans and Their Ancient Language

The Yahgans, who inhabited the southern shores of Tierra del Fuego and the southerly archipelagoes, were the first tribe to have contact with the Europeans, and significantly their numbers are fewest today. A century ago mariners feared the natives, probably more from exaggerated tales than from first-hand knowledge. Surely there was nothing intimidating about the appearance of the Yahgans. small—hardly five feet—in stature, with thin legs, ugly and deformed. They were semi-nomads who traveled from island to island, obtaining their living chiefly from the sea. Within their sheltered channels were great submarine forests of kelp, with stems over 30 meters long,[29] forming a feeding ground for shoals of fish and a natural breakwater

[28] S. K. Lothrop: The Indians of Tierra del Fuego, *Contribs. Museum of the Amer. Indian, Heye Foundation*, Vol. 10, New York, 1928; reference on p. 16.

[29] Spiess (*op. cit.*) mentions finding pieces of kelp 17 meters in length along the African coast, carried from Tierra del Fuego by the west-wind drift.

for their canoes. On their outer islands were seals, and now and then a dead whale was washed ashore to provide a real feast. They had also sea fowl, edible crabs, and many varieties of mussels, huge and succulent—the last described by the English missionary, Dr. Thomas Bridges, as their chief food. For vegetables they had wild celery, cresses, dandelions, and roots of tussock grass; for fruits, wild strawberries and currants. There were ten varieties of fungus growing upon living or recently dead trees that were also eaten, but fungi growing upon the ground were never touched. Yet, despite all these food supplies at their command, the Yahgans knew both hunger and famine, due not alone to their improvidence but also to the prolonged storms that were apt to isolate groups of them upon islands without food.

A remarkable work indeed is the Yamana-English dictionary published last year by the children of the Rev. Thomas Bridges from notes kept by their father during his lifetime among these natives.[30] Yamana, it should be explained, is the Yahgan designation for themselves, i.e. the "people." The name Yahgan was given them by Dr. Bridges himself, from the coasts of the Murray Narrows, called Yahga by the natives, where his mission was established. Some 32,000 words are listed in the dictionary. The vocabulary is not mixed or overlaid by the speech of other tribes, not even of the immediate neighbors—an indication that Yahgan is an ancient and a pure tongue. Dr. Bridges had noted that there are no traces of other languages in their place names (save only Ona and Alacaluf in bordering parts), which indicates that no others preceded or shared with the Yahgans the occupation of these southernmost shores. Among the citations from Dr. Bridges' notes and diaries in the prefatory pages of this work are certain compound terms in daily use, the parts of which cannot be traced in the present language, out of which they have vanished save in this compound form—a further proof of the age of this language. Whereas many of the Yahgan words are due to multiplication, primary words are quite numerous: there are seven distinct words, for instance, to designate shells of various shellfish. We had hoped to find many examples of Yahgan place names in this dictionary, but there are only a few. The word "patag-ŏnĭa" appears, with the translation "to be said of any broad thing or surface": doubtless the Yahgans picked up this word from contact with outsiders, using it as a general descriptive term.

The Alacaluf Indians

Our knowledge of the Alacalufs is sparse. Also canoe Indians, and in appearance not unlike the Yahgans, they inhabit both islands

[30] Thomas Bridges: Yamana-English, a Dictionary of the Speech of Tierra del Fuego (edited by Ferdinand Hestermann and Martin Gusinde), Mödling, Austria, 1933. It is to the compilers of this work, from Dr. Bridges' notes, that we are indebted for the foregoing data relating to the food of the Yahgans.

and mainland north of Brecknock Peninsula and west of Isle Dawson. With the penetration of the white man these people moved westward and northward to regions within the intricate network of channels and islands at which they were less likely to be disturbed. It was the Alacalufs who were found by FitzRoy and Darwin a century ago along many of the passages and inlets of the Pacific south of the Taytao Peninsula. FitzRoy divided them into three groups: the Pecherays in the strait region, the Huemuls at Otway and Skyring Water, and the Chonos to the northward—the term Alacaluf being a general name. The Chonos have much in common with the Chilotes, who in turn are linked to the Changos, so that through the Alacalufs there may possibly be a connection all the way from the Yahgans to the now extinct fishing tribes of Chile's north. Opposing this theory is the lack of similarity between either the Yahgan or Alacaluf tongue and any other linguistic group.

Whence originated these fisher folk of Chile's south? Hildén's recent examination of a skull from the Tierra del Fuego archipelago (whether Yahgan or Alacaluf was not known) found this to exhibit many primitive characteristics, such as would confirm theories of a connection between these natives and those of the Austro-Melanesian islands.[31] Did these people perhaps originally come to South America in their canoes via the shortest route, while other tribes were following the land route via Asia and Alaska?

The Onas and a Mysterious Migration

In the Onas we find another of the remarkable contrasts common in the region. Large and powerful, these "foot Indians" differ radically from the "canoe Indians" already described. Nomads of the land, they shun the water. The term Ona is the Yahgan designation for these people; they call themselves Selk'nam. They have no permanent villages, the community life centering about a single family and its descendants. Father Gusinde[32] describes their secret ceremonies, rites at which the medicine man held sway, at which men personified the forces of nature—the mountains, the stars, the snowflakes, and the like. The last rites took place during the winter of 1923. A few months later an epidemic wiped out many of the survivors of this tribe, and with them disappeared these festivals, representing an unchanged remnant of mankind's earliest days.

Father Gusinde describes the Onas as divided into three dialect groups—the Haush in the extreme southeast of Tierra del Fuego and the southern and northern Onas, divided by the Río Grande. These

[31] Kaarlo Hildén: Weiterer Beitrag zur Kraniologie der Feuerländer, *Acta Geographica* 4, No. 1, 1931.

[32] Martin Gusinde: Zur Forschungsgeschichte der Feuerland-Indianer, *Mitt. Geogr. Gesell. in Wien*, Vol. 73, 1930, pp. 247–253.

tribes are clearly related to the Tehuelches of the Patagonian mainland, and there has been much speculation as to when and how they crossed the strait. Lothrop, although finding no archeological indication as to when these people reached Tierra del Fuego, considers that no aspect of Ona culture implies separation from the continent for more than a few centuries before the voyage of Magellan. Other writers go back thousands of years to bring the Onas across the strait on glacial moraines that were later cut through by the waters that they impounded, this theory being supported by an Ona tradition quoted by Beauvoir[33] that their forefathers crossed by a land bridge that was later destroyed in a cataclysm. Caldenius[34] shares this belief that the Onas, with their guanacos and other animals, crossed to Tierra del Fuego on a terminal moraine. Otto Nordenskjöld's theory was that the Onas crossed the strait casually, perhaps from curiosity, in the good-sized canoes of the Alacalufs, and his theory is quoted by De Agostini in his book on Tierra del Fuego.[35] Lothrop[36] concurs with this opinion that the Onas were conveyed across by the Alacalufs.

But do we need either of these complex theories to explain one of the world's ordinary tribal migrations? Throughout history we find man constantly adapting himself to new conditions and environment. So perhaps with these Tehuelches who became the Onas. Land people, they turned to the water to meet a great emergency—failure of their food supply, perhaps, or encroachments of their neighbors. They built themselves boats—frail craft at first, no doubt, but improving as early losses of life brought a realization of the difficulties of the passage.[37] The migration completed, the Onas gradually laid aside their boats; with new hunting grounds at hand they could have had little need for them. We now come to a time interval: that such existed we know from Lothrop's survey of the garments with painted decorations in general use throughout southern South America—decorative motives that he found completely absent in Tierra del Fuego, leading him to the deduction that the Onas were separated from their mainland kinsmen for some centuries.[38] How many years were spanned by the migration, how many generations might have been needed for the transition from Onas who could use boats to Onas who had lost interest in treacherous waters and had become completely readapted to a dry-land environment, we do not know. Nor can we even be certain that the Onas had completely discarded their

[33] J. M. Beauvoir: Los Shelknam Indigenas de la Tierra del Fuego, Buenos Aires, 1915, p. 201.

[34] Caldenius, Las glaciaciones cuaternarias en la Patagonia y Tierra del Fuego.

[35] I miei viaggi nella Terra del Fuoco, Turin, [1923].

[36] Lothrop, *op. cit.*

[37] Mr. Lothrop's description of canoes used by the Yahgans in the stormy waters off Cape Horn encourages us to assume that some at least of the early Onas who might have "blundered" out into the strait reached their destination in safety. (Aboriginal Navigation Off the West Coast of South America, *Journ. Royal Anthropol. Inst.*, Vol. 62, 1932, pp. 229–256).

[38] S. K. Lothrop: Polychrome Guanaco Cloaks of Patagonia, *Contribs. Museum of the Amer. Indian, Heye Foundation*, Vol. 7, No. 6, New York, 1929.

canoes before Magellan's voyage, for one of the older maps[39] contains the inscription, referring to the Bahía de Jente Grande: "Bay of the Giants which were seen by Sarmiento in 1580. Indian Hutts. These Indians are of a good size; they cross the Straits in Canoes made with the Bark of Trees." Had this early traveler confused the foot Indians with canoe Indians he had seen? If not, these "Indians of a good size" who used canoes could have been none other than Onas.

Southern Patagonia's Future

A few years ago we might have agreed with Dr. Wellington Jones's general remark concerning the southern territories of Argentina and Chile that continued development will "rest on agriculture—sheep or cattle ranching for the most part, with subsidiary crop raising in places."[40] Now the writer ventures the opinion that in southern Patagonia metal production is to hold sway with agriculture of secondary importance, only to supply food to mining populations.

Most important of the region's potential resources is its gold. Glacial moraines in Patagonia have been found to contain gold, and the metal has also been found concentrated by stream flow in certain rivers and by wave action along certain coasts. Yet of the primary deposits from which these findings originated little is known; the veins are believed to be of greater age than the Tertiary, and they probably exist in the older crystalline schists (Paleozoic) and in the metamorphic rocks. Certainly there is every reason to believe that important primary deposits do exist, if only from the fact that gold has been found in association with large crystalline fragments discovered among glacial débris. The problem remains to locate the deposits, a problem indeed, for the geological formations of the cordillera region, covered in large part with virgin forest and almost impenetrable undergrowth, thick strata of decaying vegetation, and, finally, glacial deposits to hundreds of meters' thickness, are difficult to study. Even more difficult to prospect are the ice and snow-covered areas, where the underlying rocks appear only at a few walls too steep to hold snow. Not even the late developments in geophysical prospecting have thus far proved of much value in this region. But mankind's search for gold, extending back over thousands of years and covering nearly all the earth's regions, has narrowed down to a limited number of localities. Southern Patagonia is one of these.

As for other minerals—again our knowledge is scanty. Fester mentions samples of copper ores that he saw, presumably from the west of

[39] A Chart of the Straits of Magellan. Inlarged from the Chart Published at Madrid in 1769. by Don Juan de la Cruz Cano y Olmedilla . . . and Improved from the Observations and Surveys of Captns. Byron, Wallis and Carteret compared with those of Monsr. de Bougainville. London, 1775.

[40] Present Status and Future Possibilities of Agricultural Land Utilization in Patagonia, *in* Pioneer Settlement. *Amer. Geogr. Soc. Special Publ. No. 14*, 1932, pp. 124–145; reference on p. 144.

the territory,[41] and De Agostini refers in a vague way to small veins of copper in the cordillera. The truth is that, aside from the lignite mines near the city of Magallanes, within a stone's throw of a world artery of travel, but little mining has thus far been done in this region. Positive indications of petroleum, consisting of ebullitions of hydrocarbonic gases, of oil sandstones, and of bitumen thrown up by the sea, led the Chilean government to sponsor an investigation near Magallanes a few years ago, and, although the results of this particular boring were negative, certain additional evidence was produced to encourage rather than discourage further search.[42] We have less reason to conclude that the potential mineral resources of southern Patagonia are too few than that the obstacles to finding them have been too great.

When and if mineral deposits are found in southern Patagonia, resources of energy so necessary to exploiting them are close at hand. The heavy rainfall and the steep slopes of the drainages will make hydro-electric power available at comparatively low installation costs. Nor is this all: along the Atlantic the configuration of the coast and the considerable range in diurnal tides previously referred to provide opportunity for economical development of tidal power by low-head hydraulic turbines. A study[43] of these resources shows 3,700,000,000 kilowatt hours a year from tides at the mouth of the Río Santa Cruz, 1,900,000,000 kilowatt hours a year at Puerto Gallegos, and smaller amounts at Bahía San Julian and Río Deseado. Finally, there are potentialities for developing additional power from the strong winds.

The vast water-power resources of the southern Andes suggest some interesting possibilities for the future. Should the inland ice fields interfere with his activities with the metals that may be found here, man has the means of combating and eventually of destroying them. Hydro-electric energy, converted to thermal energy,[44] may be called upon to remove particular ice masses that obstruct progress on his mining developments, or to undermine slowly but surely the delicate balance that has made the survival of these temperate-zone ice fields possible. A mammoth undertaking, to be sure, even for the superenlightened man of the future, but not impossible. In fact, he may here learn the way to delve beneath the ice cap of Antarctica.

[41] Fester, Algunas observaciones de un viaje a la Patagonia.

[42] Jules Decat and R. Pomeyrol: Informe geológico sobre las posibilidades petrolíferas de la Región Magallánica, *Bol. Minero, Soc. Nacl. de Mineria*, No. 389, Vol. 43, 1931, pp. 763–772.

[43] N. Besio Moreno: Mareas patagónicas—Estudio para su utilización industrial, *Revista Electrotecnica*, Vol. 15, 1929, pp. 209–212.

[44] It requires about 100 kilowatt hours of electrical energy, converted to thermal energy (allowance having been made for lost efficiency), to melt a cubic yard of ice. Hydro-power installations of 100,000 kilowatts' output (only a fraction of southern Patagonia's available water energy) would be capable of melting and raising 10 to 20 degrees Fahrenheit in temperature 1000 cubic yards of ice an hour. If such power was used only at off-peak hours of the night and at daybreak, say 8 hours a day, it could be made to melt about 3 million cubic yards of ice a year.

POPULATION TRENDS IN NORTHWESTERN NEW ENGLAND, 1790-1930

Harold Fisher Wilson

READERS of the *Geographical Review* have already had opportunities to learn of population trends in representative regions of Vermont and New Hampshire,[1] but no such study has heretofore been made for all the townships of these two states. The accompanying series of maps has been drawn with that purpose in view.

The Period 1790–1830

The first four maps of the series show the movement of population in the towns of New Hampshire and Vermont in the decades between 1790 and 1830. This was a period of self-sufficiency in agriculture, when the farmers and their families derived their subsistence chiefly from their farms and sold only the incidental surplus for cash or bartered it for merchandise. Most sections of these states, blessed with the vigor of youth, grew rapidly. The population of Vermont increased in this period from 85,341 to 280,652, that of New Hampshire from 141,899 to 269,328. The greater number of towns gained consistently. In the northern parts of both states most of the losses in numbers occurred between 1810 and 1820: the War of 1812, with the fear of British and Indian invasion from Canada, tended not only to restrict immigration into these new and sparsely settled regions but also to persuade many of the more faint-hearted to retrace their steps southward. Out of thirteen Vermont towns facing the border, eight lost in population in this decade. The hard times that followed the war were another influence leading to a loss of population during this decade, particularly in the central and southern sections of the two states, while still more widespread in its effect upon the area was the distress caused by an almost total crop failure in 1816.[2]

Although by far the greater number of towns in both states grew constantly during this period, by its end a marked and steady decrease in population had set in in the earlier settled parts. The call of the new lands to the north and sporadic migration from the older communities into western territory accounted for much of this drop. In long-occupied Rockingham County, in the southeastern corner of New Hampshire, a number of towns decreased in population in more than one decade of these forty years, while the southeastern corner of Vermont, the first area in the state settled by white men, was also losing

[1] See, for example, J. W. Goldthwait: A Town That Has Gone Downhill, *Geogr. Rev.*, Vol. 17, 1927, pp. 527–552, a study of the township of Lyme, N. H.; and H. F. Wilson: The Roads of Windsor, *ibid.*, Vol. 21, 1931, pp. 379–397, an investigation of the Windsor region in Vermont. See also "New England's Prospect, 1933," *Amer. Geogr. Soc. Special Publ. No. 16*, 1933.

[2] Walter Crockett: History of Vermont, New York, 1921, Vol. 3, pp. 131–135.

heavily. Between 1820 and 1830 a further group of towns in south-central New Hampshire experienced its first drop in population. In the last decade 39 of the 245 towns in Vermont decreased in number of inhabitants, while in New Hampshire 61 of the 228 towns showed decline, all but one—Lyme—being in the southern part.

The Period 1830–1870

The maps for the period between 1830 and 1870 illustrate the trend during the transition from a self-sufficient to a commercial agriculture—a trend hastened by the advent of the railroad into New Hampshire in the late thirties and into Vermont in the middle forties. The region was further disturbed during these years by such exterior factors as the development of the West, the lure of the growing cities to the south, and the upheaval caused by the Civil War. This period saw the flourishing of the sheep industry on the upland farms, and in these decades the rural population of the territory reached high tide. New Hampshire had attained its maximum by 1840, while the total for Vermont began to decline about 1850.[3]

During this period the area losing population advanced northward until some of the earlier settled sections in the central parts of both states show a drop in numbers for every enumeration of the census in these years. On the other hand, much of the northern area gained constantly during the entire period, particularly Coos County in New Hampshire and Orleans and Essex counties in Vermont. These regions were still comparatively new and undeveloped. Most of the remaining bright spots on these maps, scattered through the central and southern sections of the two states, were either thriving industrial cities or towns whose nonagricultural village population was steadily increasing because of growing pay rolls in small textile mills, woodworking establishments, and the like.

From 1870 to 1900

The decades from the seventies to the end of the century and in many isolated hill localities even to the present were years of marked decline in rural population and in improved farm land. Inability to meet western competition and Australian and South American imports of wool practically wiped out the sheep industry, while increased competition from western staple crops and the widespread exodus of young people to the cities of southern New England and New York left the hill country with little prospect for the future.

Excluding the cities, 59 per cent of the towns in Vermont lost

[3] William Rossiter: Vermont, *Quart. Publs. Amer. Statistical Assn.*, Vol. 12 (N.S.), 1911, pp. 387–454: reference on p. 421. More Vermont towns reached their maximum recorded population in the census enumeration of 1830 than at any other date (*ibid.*, p. 415).

1790-1800
1800-1810
1810-1820
1820-1830
1830-1840
1840-1850
1850-1860
1860-1870
1870-1880
1880-1890
1890-1900
Grand Isle

274

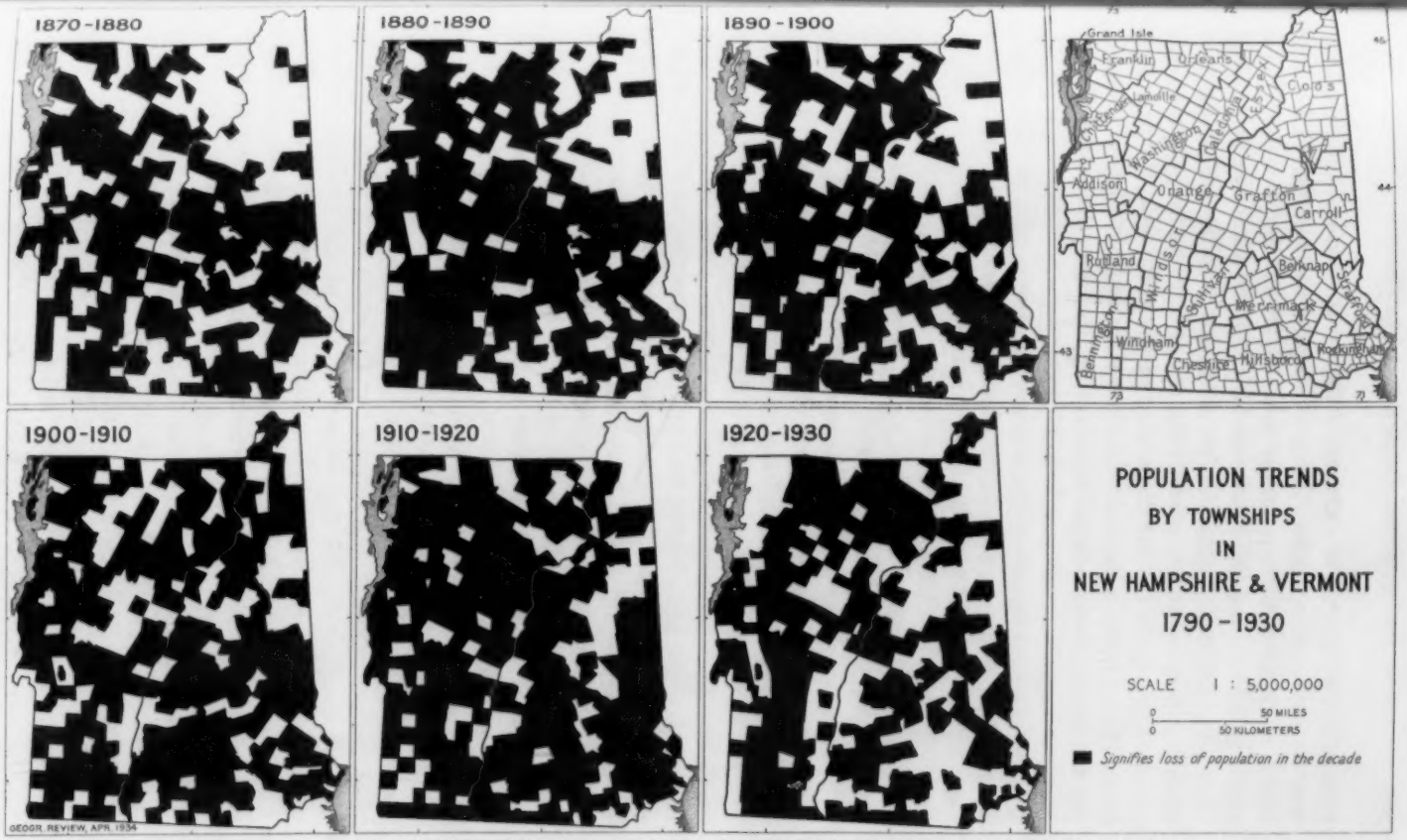

FIG. 1—A series of maps of northwestern New England showing townships that have suffered loss of population (solid black) by decades from 1790 to 1930.

population from 1870 to 1880, while the proportion in New Hampshire was 53 per cent. During the next decade the number of Vermont towns decreasing in population reached its maximum—81 per cent showing losses—and the total population of the state rose by only 136 (from 332,286 to 332,422). A few scattered localities that maintained their position by an increase in the nonagricultural population and a group of towns in the northern part of the state were the only areas that did not suffer a decline. In New Hampshire about two-thirds of the towns decreased in population during this time, the greater number being situated in the rough hill country away from the railroad. During the last decade of the century the proportion of New Hampshire towns losing in population remained about the same, while in Vermont it dropped from 81 to 72 per cent.

Trend in the Twentieth Century

The most recent phase of the agricultural history of northwestern New England dates from the first years of the twentieth century and is still in progress. Although up to the 1930 census rural population continued to decline in number and the number of farms to decrease, there has been accentuated specialization on those continuing to be occupied. The hill-country husbandman, realizing that he could not raise grain or beef or wool in competition with the West, began to concentrate on commodities where bulk, quality, and freshness were of primary importance. This development was most striking in the instance of the dairy industry.

Between 1900 and 1910 more than two-thirds of the towns in Vermont show a fall in population, but the decrease was more than offset by the growth of the few urban centers of the state, and the total population rose from 343,641 to 355,956. The same situation obtained in New Hampshire, where four-fifths of the towns lost during these years, although the returns for the state as a whole rose from 411,588 to 430,572. In the second decade of the century Vermont experienced the first decline in her history as a state when she suffered a loss of 3528 people, a fall of about one per cent. Three-quarters of the 238 towns had fewer inhabitants in 1920 than in 1910, and only 58 towns reported gains, twelve of less than one person a year. In New Hampshire 76 per cent of the towns showed fewer people in 1920 than in 1910, although the population of the state mounted from 430,572 to 443,083. The greater decline in this decade was due to a considerable extent to the migration toward industrial centers arising from the World War. Vermont had few cities, and no large ones, while in New Hampshire only parts of the southern portion were predominantly urban, but both lay at the door of a great manufacturing territory.

In the last decade of the period, however, fewer towns in Vermont decreased in population than in the previous ten years, 64 per cent reporting a smaller number of inhabitants in 1930 than in 1920, while in New Hampshire only 49 per cent lost in residents. During this time many towns in both states experienced a rise in numbers, due in most cases to an increase in the village population. New industries offering employment occasionally arose in small towns. Elderly couples frequently closed the home place and moved into a near-by community when it was no longer possible for the old man to carry on the farm. The unemployment following the depression in the early twenties and the more severe one of the early thirties also brought people into the little rural villages. City families came to stay with relatives until times were better, or they moved to the country because rents were cheaper and it was possible to raise a part of their food. Indeed, the considerable growth in the number of people living under predominantly rural conditions, although not on a farm, was a pronounced trend in the population movement of northwestern New England during the past decade.[4]

It is possible that a number of localities may have reached their minimum population. Between 1920 and 1930 a group of towns in New Hampshire and Vermont that had shrunk constantly since attaining their maximum growth—the majority before the middle of the last century—for the first time registered slight increases. While it is still too early to prophesy with certainty, the high point in the decline of rural population in the hill country seems to have been reached, and as the region becomes still further adjusted to modern conditions it is probable that the number of inhabitants will tend to remain fairly stationary.

[4] See "Fifteenth Census of the United States: 1930: Population," Vol. 3, Part 2, U. S. Dept. of Commerce, Bur. of the Census, Washington, 1932, pp. 153 and 1117.

THE METROPOLITAN REGIONS OF THE UNITED STATES

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OUR approach to this study in urban geography is threefold: the selection of those cities of the United States that are metropolitan; the delimitation of the regions served by them in various functional capacities; the delimitation of the composite metropolitan regions and the interpretation of the functions of the metropolitan cities in relation to the economic character of the regions they serve. First, however, the concept "metropolitan" must be defined, for the term is unfortunately often used as vaguely expressing the quality of a large city. The 1930 census of the United States defines a metropolitan district as an urban unit "having an aggregate population of 100,000 or more, and containing one or more central cities of 50,000 or more inhabitants," and recognizes 96 such districts.[1] Only a few of these, however, are metropolitan according to our definition as already applied to the cities of England and Wales.[2]

Accepting the definition of metropolitan economy as "the organization of producers and consumers mutually dependent for goods and services, wherein their wants are supplied by a system of exchange concentrated in a large city which is the focus of local trade and the center through which normal economic relations with the outside are established and maintained,"[3] a city becomes metropolitan "when most kinds of products of the district concentrate in it for trade as well as transit; when these products are paid for by wares that radiate from it; and when the necessary financial transactions involved in this exchange are provided by it."[4] Such a city will have a population considerably larger than that of surrounding towns; it will be an independent center of trade, with a large variety of regional industries and a large wholesale business; it will be a financial center and finally a cultural and administrative center. It does not follow that integration is always in one center, however, for frequently two or more cities, serving the same region, subdivide the sum of the metropolitan functions.

[1] Fifteenth Census of the United States: 1930: Metropolitan Districts, Population and Area. Prepared under the Supervision of Clarence E. Batschelet, *U. S. Dept. of Commerce, Bur. of the Census*, Washington, 1932, p. 6. See criticism of this definition in Mark Jefferson: Great Cities of 1930 in the United States with a Comparison of New York and London, *Geogr. Rev.*, Vol. 23, 1933, pp. 90–100, and W. Winid: The Distribution of Urban Settlements of over 10,000 Inhabitants in the United States in 1930, *Scottish Geogr. Mag.*, Vol. 48, 1932, pp. 197–210.

[2] R. E. Dickinson: The Commercial Functions of the Nuclei of the English Conurbations, *Sociol. Rev.*, Vol. 21, 1929, pp. 38–49; see also *idem:* The Regional Functions and Zones of Influence of Leeds and Bradford, *Geography*, Vol. 15, 1929–1930, pp. 548–557.

[3] N. S. B. Gras: An Introduction to Economic History, New York and London, 1922, p. 186.

[4] *Ibid.*, p. 294.

Metropolitan Cities of the United States

In order to select from the United States census list those cities that, in accordance with our concept, are metropolitan, several criteria have been chosen. The first is the value of sales per capita of manufactured, wholesale, and retail goods for cities with over 50,000 inhabitants.[5] Retail sales (per capita) do not show a very wide range,

Fig. 1—Urban settlements of the United States in 1930.

differences between cities depending on the areal extent and purchasing power of the market and the competition of other centers. The other two, however, range widely. The principal wholesale cities (over $1000 sales per capita), with the exception of several specialized markets (mainly cotton and livestock), are all 100,000 cities, and together, a total of 37, they contain a little under one-quarter of the total population of the nation but two-thirds of the wholesale trade by value.

A large number of cities are low in wholesaling (under $500 per capita), and many of them are also low in retailing. Cities of this category are grouped around the large cities, especially in the north-central states. They are typically manufacturing communities. All cities of this kind are themselves tributary to metropolitan cities and may be excluded from further consideration; examples are Akron, Canton, South Bend, Lowell, Lawrence.

In Figure 3 the classification combines manufacturing and wholesale sales. Grouped in the northeast are the largest manufacturing

[5] Fifteenth Census of the United States, 1930: Census of Manufactures and Census of Distribution (Wholesale and Retail Trades). Wholesale trade statistics throughout the article are taken from the State reports of the Census of Wholesale Trades.

and wholesale centers (over $1000 sales per capita). Three of these—New York, Boston, and Minneapolis—have wholesaling considerably in excess of manufacturing; five have a considerable excess of manufactures; and several are fairly high in both functions. In the remainder of the country, with the exception of San Francisco, Nashville, and Louisville, all the large cities are high in wholesaling and low in manufacturing sales.

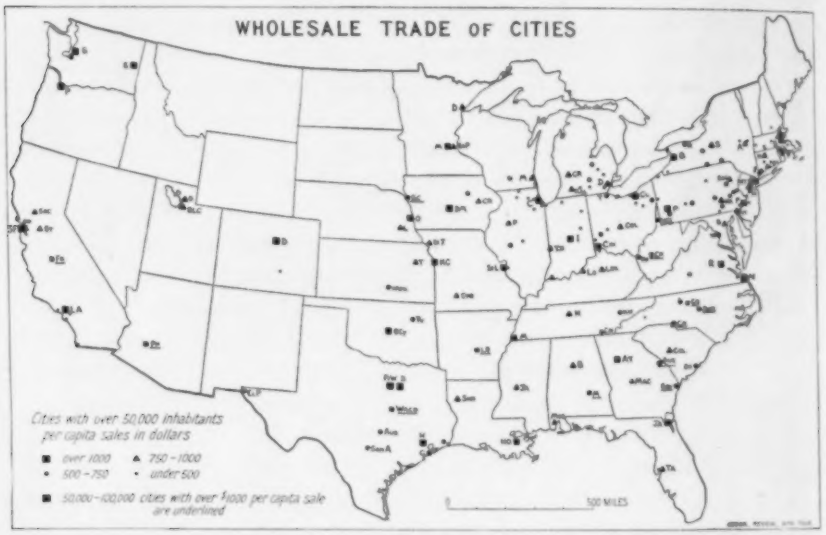
WHOLESALE TRADE OF CITIES
Cities with over 50,000 inhabitants
per capita sales in dollars
over 1000
750 - 1000
500 - 750
under 500
50,000 - 100,000 cities with over $1000 per capita sale are underlined
500 MILES

FIG. 2—Wholesale trade of cities of the United States with more than 50,000 inhabitants.

Other criteria will broaden the basis of and strengthen this functional classification. Thus there is the distribution of merchandising warehouse space. It has been calculated that 90 per cent of the total is concentrated in 26 cities.[6] Again, we may consider the sales and distribution effected through branch offices, warehouses, and manufacturing plants. Twenty large national concerns[7] have been selected and the location of their district branches noted and totaled. The location of Federal Reserve banks and branches and bank clearings has also been studied.[8] Several of the 37 cities do not function in any of these three capacities as metropolitan centers.

From these data it has been concluded that the following are metropolitan cities of the first order: Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas-Fort Worth, Denver (?), Detroit, Kansas City, Los Angeles, Minneapolis-St. Paul, New York, Philadelphia, Pittsburgh, St. Louis, and Seattle. Metropolitan cities

[6] E. A. Duddy: Regional Distribution of Public Merchandise Warehouse Space in the United States, *Distribution and Warehousing*, 1928.

[7] Thomas' Register of American Manufacturers, New York. [Published annually.]

[8] Location of Federal Reserve Districts in United States, *63rd Congr., 2nd Sess., Senate Doc. 485*, 1914; see Gras, *op. cit.*, p. 296, for map.

of the second order are: Birmingham, Jacksonville, Omaha, Richmond, Houston, Memphis, Portland, Salt Lake City, Louisville, Milwaukee, New Orleans, and Spokane.

The Metropolitan Region

Around each metropolitan city there tends to develop a series of zones of influence, each with common relationships with the center.

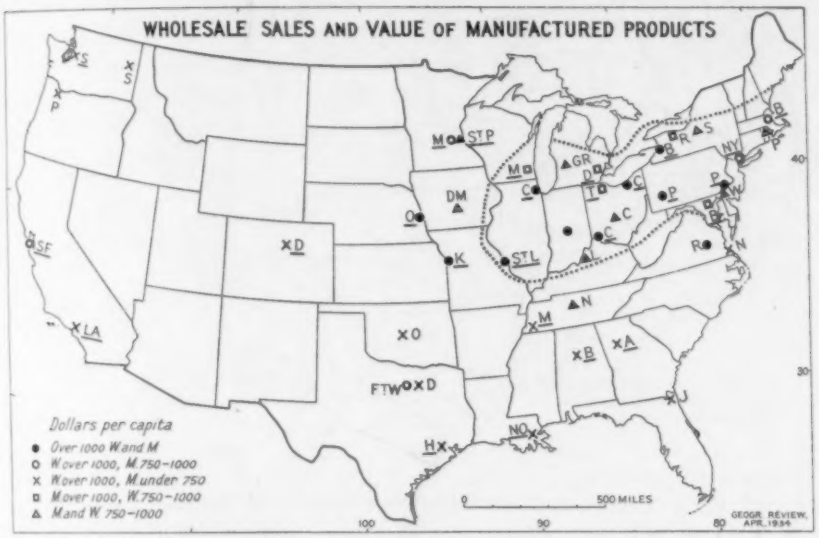
WHOLESALE SALES AND VALUE OF MANUFACTURED PRODUCTS
Dollars per capita
Over 1000 W and M
W over 1000, M 750–1000
W over 1000, M under 750
M over 1000, W 750–1000
M and W 750–1000
500 MILES
GEOGR. REVIEW, APR. 1934

FIG. 3—Wholesale sales and value of manufactured products in the United States.

The ultimate limit of the sphere of urban influence is defined by the limit of the trade area—the hinterland of the port, the "umland," to use a parallel term, of the inland city. This is the metropolitan region with which we are here primarily concerned.

The commercial functions of a metropolitan city are collection and distribution. It assembles and redistributes the primary and manufactured products of the region, and the character of its activities varies according to the character of its region. The products of distribution, however, are more standardized, except for the supply of materials to industries in tributary towns; for example, cotton at Boston, metals and minerals at Cleveland, Pittsburgh, and Detroit. With commodity distribution must be included all types of services, of which the most important is the circulation of newspapers and printed matter: printing and publishing is, indeed, one of the most important and distinctive industries of the metropolitan city. All these distributed commodities are either imported to the city or manufactured in it. Consequently a full-fledged metropolitan city is characterized by the great diversity of its regional industries and a growing

metropolitan city by the rapid increase of such industries, as it strives to assert its independence of other centers.

The degree of concentration of the total commodity movement in a metropolis and the extent of the region within which the movement to and from it takes place depend on the location and site of the metropolis, on the degree of development of both the metropolis and

WHOLESALE TRADE AREAS
Market Data Handbook of United States,
Bureau of Foreign and Domestic Commerce.
Domestic Commerce Series, No.30
500 MILES

FIG. 4—Wholesale trade areas of the United States.

the region, and on transport facilities, particularly freight-rate structure.

Of various service-area maps used in determining the boundaries of the metropolitan regions Figures 4 to 7 have been selected for reproduction. Figure 4 shows wholesale trade areas. Many trade areas have been defined for the country with a view of forming a framework and a sound economic basis for the distribution and sale of wholesale products. Figure 4 is based upon a grouping of several hundred jobbing and retail trade areas in such a way that each area is focused on one central warehousing center.[9]

Newspaper circulation (Fig. 5) has been demonstrated to be a delicate indicator of the extent and potency of urban influence.[10] Circulation can be accurately determined from the records of the Audit Bureau of Circulation. Figure 5 has been prepared on this basis by the Social Science Research Committee at the University of Chicago.

Figures 6 and 7 are concerned with the marketing of agricultural

[9] P. W. Stewart: Market Data Handbook of United States, *U. S. Bur. of Foreign and Domestic Commerce, Domestic Commerce Ser. No. 30*, 1929; J. W. Millard: Atlas of Wholesale Grocery Territories, *ibid., No. 7*, 1927.

[10] R. E. Park: Urbanization as Measured by Newspaper Circulation, *Amer. Journ. of Sociology*, Vol. 35, 1929, pp. 60–79.

products. The chief livestock markets of the country fall into four groups. Salt Lake City, Ogden, and Denver collect range sheep and cattle and ship them east for fattening; the High Plains and Middle-western group, the chief markets, are the slaughtering and packing centers; Buffalo, Cleveland, and Pittsburgh have considerable receipts of all kinds of stock,[11] serving an area in which stock are bred and

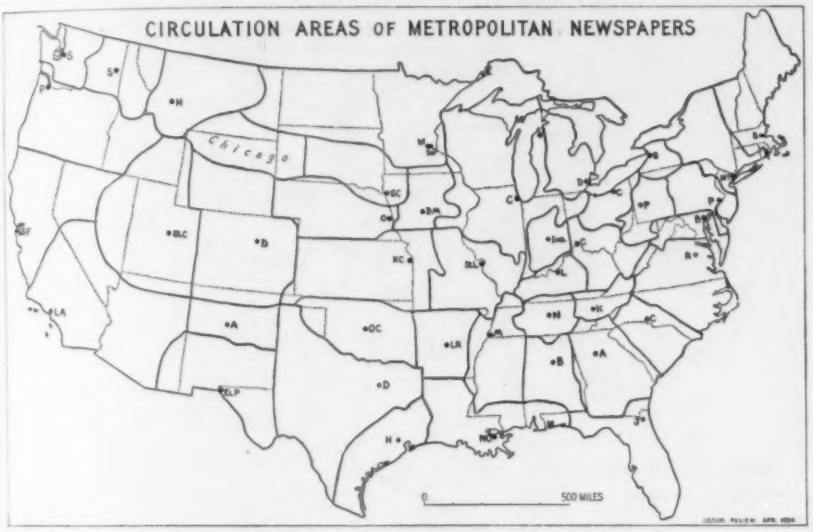

FIG. 5—Newspaper circulation areas in the United States (see Fig. 6, p. 107, in R. D. McKenzie: The Metropolitan Community, 1933).

fattened and to which only small supplies come in from the West; and the Atlantic-seaboard markets, where, in proportion to population, stock receipts are small, and the large cities are principally centers for warehouse distribution by the large meat-packing companies. The South and the Pacific seaboard depend on local supplies and local distribution by the meat-packing companies.

The composite areas of livestock supply of nine Midwestern markets are shown on Figure 6, generalized from a series of three maps—for cattle, hogs, and sheep.[12] The three areas closely correspond, although large supplies of store sheep are drawn from the Far West. In the northern states of the intermontane belt supplies are sent to several markets. Western Montana, indeed, has its chief market in Chicago.

The great bulk of grain shipments to primary markets is focused on Minneapolis and Chicago, and data indicate the close correspond-

[11] Sources of Cattle Receipts, Pt. 1, Monthly Letter to Husbandmen, Armour's Livestock Bureau, September, 1931, pp. 8–9.

[12] E. A. Duddy and D. A. Revzan: The Supply Area of the Chicago Livestock Market, *Univ. of Chicago, School of Commerce and Administration, Studies in Business Administration*, Vol. 2, No. 1, 1931, maps on pp. 16, 26, and 31; E. A. Duddy: The Potential Supply Area of the Chicago Livestock Market, *Journ. of Farm Economics*, Vol. 13, 1931, pp. 410–425.

ence of the grain and the livestock supply areas.[13] With Kansas City, St. Louis, Duluth, Milwaukee, and Omaha, these markets handle over 90 per cent of all grain passing through primary markets. Grain passing through secondary markets is handled mainly by Buffalo (40 per cent) and the Atlantic-seaboard group—New York, Baltimore, Philadelphia, and Boston—(55 per cent) (Fig. 7).

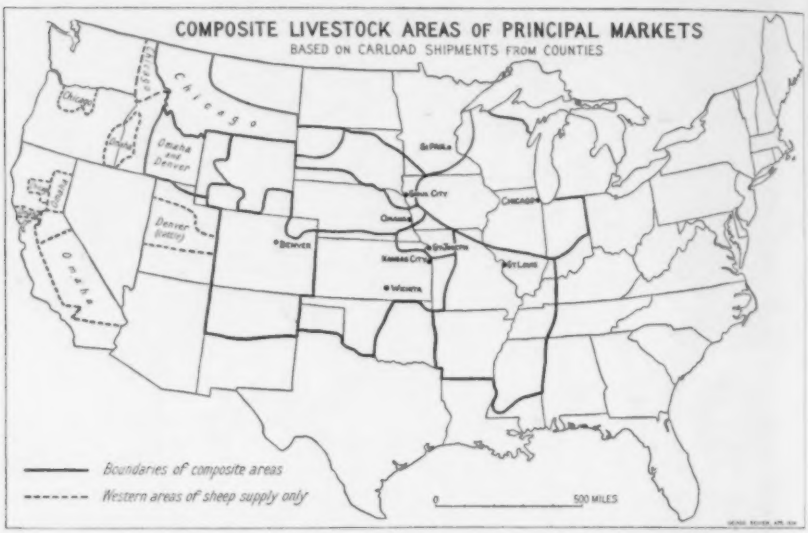

FIG. 6—Composite livestock areas of nine Midwestern markets of the United States. These areas are based upon car load shipments on a county basis for 1927, each county shipping 50 per cent or more of its total rail shipments to one of the nine markets.

Attention should be drawn to the zone of indifference between the markets of the Middle West and those of the Pacific seaboard as determined by the potential movement of hogs and grain.[14] This zone, the location of which is the expression of market prices and freight rates, is an important economic divide. It follows closely the belt between the 100th and the 105th meridians.

The marketing of cotton in the southern states is directed to a number of inland markets. Supplies for export are sent from these markets, or direct from country points, to the ports of Houston-Galveston, New Orleans, Savannah, and Norfolk, or they are sent by rail direct to the domestic manufacturing centers.[15]

[13] Analysis of Sources of Grain Receipts (1912–13 to 1916–17), on State Basis, *in* Report of the Federal Trade Commission on the Grain Trade, Vol. 2, Washington, 1920, pp. 40–41; also M. L. Hartsough: The Twin Cities as a Metropolitan Market, *Research Publs. Univ. of Minnesota: Studies in the Soc. Sciences No. 18*, 1925, and information from Duddy on grain movement on county basis to midwestern and Pacific terminals.

See also "The Grain Elevator Capacity of the United States and Its Regional Distribution" by Duddy, *Amer. Elevator and Grain Trade*, 1928.

[14] E. A. Duddy and D. A. Revzan: The Potential Supply Areas of Pacific Coast Markets for Hogs, *Journ. of Farm Economics*, Vol. 14, 1932, pp. 586–598.

[15] The hinterlands of the ports as given in the *Port Series* prepared by the Corps of Engineers of the U. S. War Department have also been taken into consideration.

Characteristics of the Regions and Cities

On the basis of our selection of metropolitan centers and the maps of areas served by the chief cities in various functional capacities a map has been prepared to show the composite metropolitan regions of the United States. The remainder of this paper will be concerned

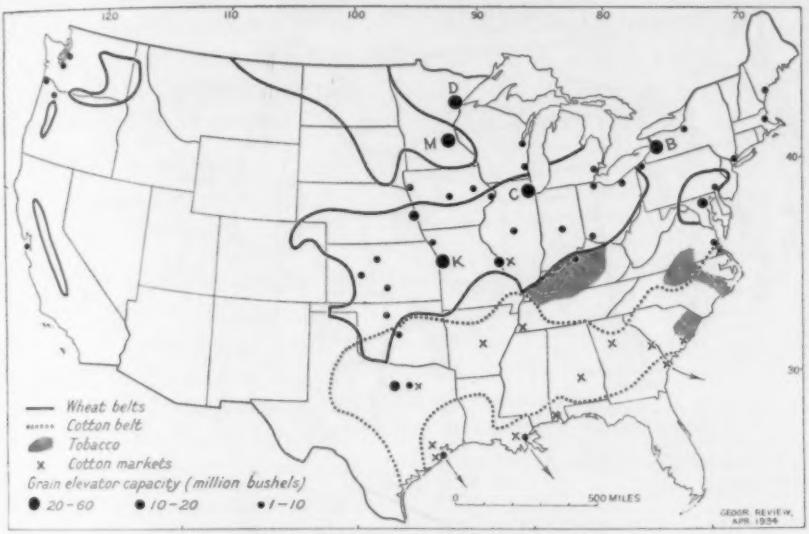

FIG. 7—Some agricultural marketing relations in the United States.

with a correlation of these regions with other types of economic regions, agricultural and industrial, and, in relation thereto, the distinctive industrial and commercial activities of the metropolitan cities will be described and explained (for the map see Fig. 8).

Centers of the Manufacturing Belt

The manufacturing belt, as delimited, for instance, by De Geer,[16] is the area of maturest metropolitan development, in which the metropolitan centers are the commercial and cultural focuses for tributary industrial towns. The remainder of the country receives the bulk of its manufactured products for general distribution from the manufacturing belt. Focal distributing points are so located that they are conveniently accessible from the manufacturing belt, i.e. located so as to keep back hauls to a minimum, and to their extensive tributary service areas; hence the central location of the southern metropolitan centers and the seaboard location of the western distributing centers receiving supplies mainly via the Panama Canal. On the Atlantic

[16] Sten De Geer: The American Manufacturing Belt, *Geografiska Annaler*, Vol. 9, 1927, pp. 233–359. Compare the grouping here suggested with Jefferson's regional grouping of population, *Annals Assn. of Amer. Geogrs.*, Vol. 7, 1917, pp. 3–15.

seaboard Boston, New York, and Philadelphia have central wholesale markets, which distribute food products and raw materials: each region and city has its distinctive industries, and each has the characteristics of a full-fledged metropolitan center. Yet the similarity of urban pattern and function, freight-rate structure, and the domi-

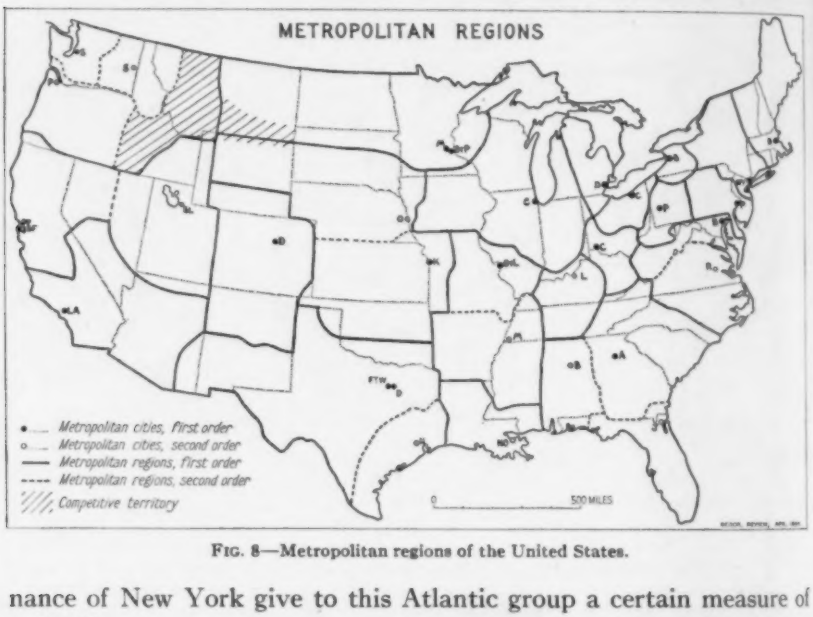

FIG. 8—Metropolitan regions of the United States.

nance of New York give to this Atlantic group a certain measure of unity.[17]

The central section of the manufacturing belt consists of a large number of industrial towns, which fall into four groups, each with its distinctive industries and focused upon a metropolitan city—Detroit, Cleveland, Pittsburgh, or Buffalo. In each of these cities metals and minerals form the chief item (20 per cent) of the wholesale trade. The group of four regions lies, like the Atlantic-seaboard group, in the hay-and-pasture belt, and each metropolis has a considerable livestock market serving a local region.

The western section of the manufacturing belt is served mainly by the metropolitan region of Chicago, which also embraces the greater part of the hog belt. This city, the economic epitome of the Middle West, combines the functions of both primary and central wholesale markets. It is a vast livestock and grain market. It has varied industries that are typically concerned with the needs of its hinterland. The chief are slaughtering and meat packing and the manufacture of

[17] J. F. Dewhurst: Commercial Survey of the Philadelphia Marketing Area, *U. S. Bur. of Foreign and Domestic Commerce, Domestic Commerce Ser. No. 1*, 1925; E. F. Gerish: Commercial Structure of New England, *ibid., No. 26*, 1929; "The Port of New York," *U. S. War Dept. Corps of Engineers and U. S. Shipping Board Port Ser. No. 20*, Part 1, Washington, 1926. In many instances the Buffalo and Pittsburgh regions are included with this Atlantic group. They definitely lie within the Atlantic-port hinterlands.

iron and steel and machine products. But in addition there are a multitude of miscellaneous industries, of which the most important are clothing, electrical supplies, chemicals, and printing and publishing. Grouped around Chicago there are a number of specialized local markets and industrial centers. The former in particular are largely dependent on trucking and draw supplies from a 75 to 100-mile radius. Such towns are Peoria, Indianapolis, Grand Rapids, and Milwaukee.

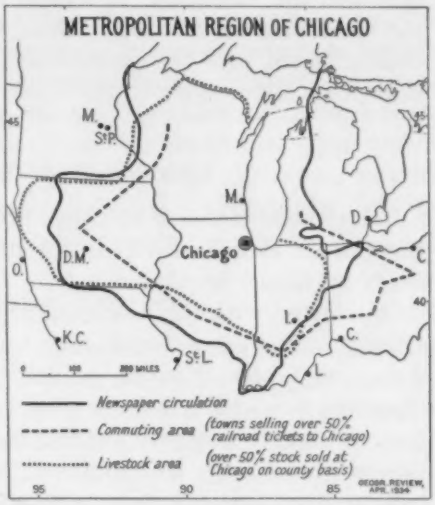

FIG. 9—The metropolitan region of Chicago (see Fig. 5, p. 102, in R. D. McKenzie: The Metropolitan Community, 1933).

CENTERS OF THE MIDDLE SOUTH

To the south of this group of metropolitan regions there is a second east-west tier, the centers of which are in part related to the manufacturing belt but also have relations with and primarily serve the Middle South. These are the regions of St. Louis, Louisville, Cincinnati, and Baltimore, which form a belt closely corresponding with the corn-and-winter-wheat belt, with tobacco as its chief money crop. St. Louis, indeed, is at the junction of the hog, cattle, cotton, and wheat belts—a favorable location, reflected in its marketing activities and its varied industries. Its historic relationships have been principally with the Southwest, where it previously shared, with Kansas City, an undisputed monopoly of the distributive trades. Indeed, this in some measure still holds good, for it handles almost 40 per cent of the hardware distribution in the southwestern states.[18] Owing to the development of the Gulf Southwest, however, the principal sphere of influence of St. Louis now lies in the middle Mississippi basin.

The Louisville and Cincinnati regions serve the Ohio basin, which includes one of the major areas of tobacco production. Approximately one-fifth of the wholesale trade of Louisville is in farm products, mainly tobacco. To the east, Richmond and Baltimore have similar characteristics. The manufacture of tobacco products is the chief industry of Richmond, situated in the middle of a second major area of tobacco production. Tobacco products account for 20 per cent of its

[18] W. A. Bowers and W. L. Mitchell, Jr.: Hardware Distribution in the Gulf Southwest, *U.S. Bur. of Foreign and Domestic Commerce, Domestic Commerce Ser. No. 52*, 1932.

wholesale trade and 30 per cent of its occupied workers. Baltimore is the focus of the small Atlantic winter-wheat area. It is the only seaboard city of the Middle Atlantic group with a grain consignment trade, and it leads in grain elevator capacity. It has large industries, due to its seaboard location, and a large distributing trade in Maryland and the Virginias. It serves, with Norfolk and Newport News, the West Virginia coalfield. Thus, like St. Louis and Cincinnati, it is closely linked with the manufacturing belt, while metropolitan functions for a large region to the south are shared with Richmond.

Centers of the Cotton Belt

The southern tier of metropolitan regions closely corresponds with the Cotton Belt.[19] Freight-rate structure has had a very different effect on urban development here from that of the northern states. In the latter, with the westward progress of the railway, the existing cities that had large distributing trades were able to attract the railways and become "basing points," with special through rates, but from which, within a definite area, cumulative freight rates are operative. This rate structure has had the effect of assisting the concentration of wholesaling. In the South, however, a number of small towns became local basing points, with special through rates to the north. This has permitted the growth of small wholesaling and jobbing centers and in addition to the special economic character of the South, has tended to prevent the dominance of any one center.

In the South two rapidly evolving centers of metropolitan integration are Atlanta and Dallas-Fort Worth. This is indicated by their large population increase—40 per cent for Atlanta and 60 per cent for Dallas in the last decade. "Regional headquarters for national distributers, central banking institutions, and large merchandising concerns have given Atlanta a metropolitan character and a direct dependence upon the prosperity and progress of every mining, lumbering, manufacturing, and agricultural enterprise in the area."[20] Dallas also claims to have the southwestern headquarters of more than 2000 concerns of sectional or national importance, and 100 of its 750 manufacturing plants are branch plants.[21] Farm supplies (livestock and grain) form over two-thirds of the wholesale trade of Fort Worth and 45 per cent of Dallas's (cotton). These two cities, however, share the metropolitan functions of the Southwest with Houston-Galveston. Similarly, Birmingham and Jacksonville are subsidiary to Atlanta in the Southeast.

[19] J. M. Hager: Commercial Survey of the Southeast, *U. S. Bur. of Foreign and Domestic Commerce, Domestic Commerce Ser. No. 19*, 1927.

[20] Hager, *op. cit.*, p. 142.

[21] C. V. Wallis: The Southwest Market and Dallas at Its Geographic and Economic Center, Dallas, Tex., 1930, pp. 43–45.

Between these two regions is that of Memphis, again primarily a cotton market (55 per cent wholesale sales), but with well diversified activities. It is to be considered, however, as subordinate to St. Louis, for the livestock marketing of the whole area is focused on that city, and much of its distributive trade and other economic relations are directed therefrom.

Finally, New Orleans is essentially a through-commodity port and not a center of metropolitan integration. It has an extensive hinterland, serving the whole of the Mississippi basin. When the Federal Reserve Bank centers were being selected, New Orleans claimed as its hinterland the whole of the South, but the banks that expressed a desire to be associated with New Orleans were, however, located almost entirely in Louisiana and Mississippi. Dallas and Atlanta were therefore selected as more suitable centers.

West-Central Centers

The Twin Cities region closely corresponds with the spring-wheat belt.[22] In the marketing of grain the Twin Cities are partnered by Duluth. The large stock market of St. Paul is a reflection of the size of its supply area and not of intensity of production. The region extends west to the "economic divide," though in southern and western Montana livestock shipments, as we have seen, are principally directed to Chicago. The distinctiveness of the Twin Cities is further reflected in the great importance of their flour milling, distributive trades, and varied light manufactures and assembly plants.

To the south there is the Omaha-Kansas City region, closely corresponding with the western—and principal—section of the winter-wheat belt and the beef-cattle area. These two cities and Sioux City and St. Joseph are all located at the western extremity of the corn and hog belts. This is reflected in the overwhelming importance, in their wholesale trade, of farm products (livestock and grain) and, in their manufactures, of slaughtering and meat packing. Some two-thirds of the wholesale sales of Omaha are farm products. Kansas City, with 45 per cent of its trade in this group, is a larger center, with a much greater diversity of commercial and industrial activities. It is definitely metropolitan on all criteria; hence it is selected as the principal center.

Centers of the West

The western states, including the intermontane belt and the Pacific seaboard, are largely dependent on the East for manufactures. San Francisco is still the chief center of distribution—a fact reflected in its many sales-territory organizations and in the extent of the

[22] Hartsough, *op. cit.* The map of the area tributary to the Twin Cities faces p. 1.

western Federal Reserve district, for which it is the headquarters. The Panama Canal has brought the intermontane belt considerably nearer to the Pacific ports, which now compete more effectively with distributors and manufacturers from the Middle West. The historic trade monopoly of San Francisco has, however, been broken in this century by the rapid metropolitan development of Los Angeles and of the ports of the Pacific Northwest.

The Pacific Northwest[23] forms a distinctive geographical unit, focused on the Puget Sound area, with Seattle as the metropolitan center but sharing its functions with Portland. Some two-thirds of the total wheat production of the whole region (Washington, Oregon, Idaho, northwestern Montana) moves through these two ports.[24] An increasing proportion of its stock is also being diverted to these centers from the primary markets in the Middle West. Regional distribution is effected by importing goods from San Francisco by water, or by local manufactures, which are increasing rapidly. To the east the region includes the Spokane area and western Montana, from which the movement of grain and stock is directed mainly to the Pacific Northwest, while general distribution from Seattle and Portland in competition with the Middle West is rendered possible on an equal freight-rate basis.

Los Angeles did not arise in response to a demand for metropolitan integration: this came subsequently. The city has, however, rapidly acquired metropolitan characteristics and for that reason may be regarded as serving a separate region, though it is closely related to San Francisco.

All the Pacific ports have local hinterlands, which, when defined on a competitive freight-rate basis, closely correspond with the regions shown on the map. None of the cities have highly specialized wholesaling activities, and none are yet high in manufactures (San Francisco is the highest with $750 per capita). Seattle and Portland handle large quantities of lumber and wheat, while petroleum dominates the shipment trade of Los Angeles. In all cases manufactured goods brought from the East make up the bulk of the port receipts, and San Francisco has important coastwise shipments to the Pacific Northwest.

Spokane, Salt Lake City-Ogden, and Denver are the metropolitan centers for the intermontane belt.[25] They are the chief centers of collection and distribution of commodities, which are purchased from Pacific or midwestern manufacturers. Manufactures are low but

[23] Edwin Bates: Commercial Survey of the Pacific Northwest, *U. S. Bur. of Foreign and Domestic Commerce, Domestic Commerce Ser. No. 51*, 1932.

[24] *Ibid.*, p. 6 and see the volumes on Seattle, Tacoma, Portland, and other ports in the *Port Series* of the U. S. War Department Corps of Engineers.

[25] See articles on population, market area, and analysis of wholesaling and manufacturing in the chief cities of the western states in the *University of Denver Business Review*, Vol. 7, 1931.

have increased in recent years through both the growth of local concerns and the establishment of branch plants. Each is the center of a distinct region, and, though small cities (Spokane, 115,500, and Salt Lake City, 140,000), they certainly have metropolitan characteristics of the second order. Spokane is the undisputed focus of a region of agriculture and lumbering, the so-called "Inland Empire"; one-third of its wholesale trade is in lumbering materials. Denver and Salt Lake City have mining interests and are also large store stock markets and general distributing centers. Spokane is tributary to Seattle, and Salt Lake City to San Francisco. Denver is considerably larger than the other two and higher in metropolitan status. But it is in some respects subordinate to Kansas City, and its selection as a "first order" city is doubtful, though its region is very definite. The "zone of indifference" in Montana and Idaho has several small mining towns that draw supplies from, and send products to, both East and West.

This completes a broad survey and interpretation of the metropolitan regions of the United States—a study that opens up a number of interesting problems and lines of investigation. The method constitutes, in our view, a fundamental problem and mode of approach in the field of urban geography.

THE RECTANGULAR STATISTICAL CARTOGRAM

Erwin Raisz

Institute of Geographical Exploration, Harvard University

THE idea of the statistical cartogram occurred to the author when he had occasion to prepare maps of the United States showing the distribution of various economic units, such as steel factories, textile mills, power plants, banks, etc. These maps were far too crowded in the northeast to be useful, while elsewhere, for the most part, they were relatively empty. If a way could be found to increase the scale of the northeastern region and reduce that of the west, distribution could be shown more clearly. Simple distortion of the map would be misleading, but, if we go a step farther, discard altogether the outlines of the country, and give each region a rectangular form of size proportional to the value represented, we arrive at the rectangular statistical cartogram. For purposes of comparison it is essential that a definite system of construction should be followed and identical arrangement should be used whatever values are represented. The system here used starts always with the larger divisions and by "proportionate halving" arrives at the smaller ones.

It should be emphasized that the statistical cartogram is not a map. Although it has roughly the proportions of the country and retains as far as possible the relative locations of the various regions, the cartogram is purely a geometrical design to visualize certain statistical facts and to work out certain problems of distribution. Examples of these cartograms are given in the accompanying figures. The division into regions follows the usage of the United States Census Bureau, because only from this source are data available. If natural geographic regions could be used instead, the cartograms would be still more instructive.

The Cartogram Illustrated

Figure 1 shows the land area of the United States. Each rectangle is equal in area to the census division for which it is named. This cartogram is included here only for comparison with the other cartograms and to show the general scheme followed in the construction. The United States is represented by a rectangle, 1 by 1½ in proportion, to which New England and Florida are attached. The three main north-south divisions are defined by lines representing roughly the western border of the Appalachians, the Mississippi River, and the Rocky Mountain front.

The second figure shows the same system of divisions, but the size of the regions is proportional to their population. The picture we get is radically different from the preceding figure. The mountain

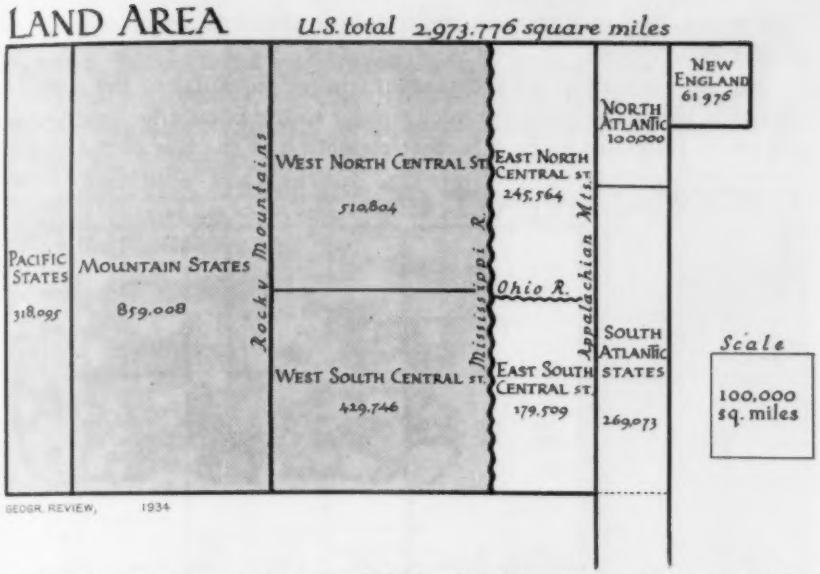

FIG. 1—A rectangular cartogram showing the land surface of the geographical divisions of the Census. This figure is intended for comparison with the following cartograms.

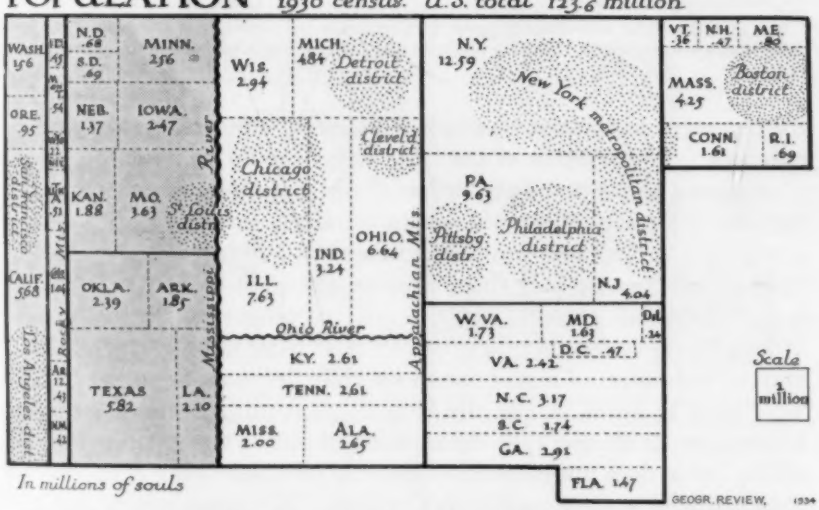

FIG. 2—Rectangular statistical cartogram with rectangles representing geographical divisions of the Census and states proportionate in size to their population. Note the position of the Mississippi River (the area west of the Mississippi is shaded in all of the cartograms).

The metropolitan districts of the largest cities (Census Bureau) are shown by a dotted area also proportionate in size to their population.

states—largest in area among the census divisions—dwindle into insignificance. The North Atlantic states grow enormously, and the Mississippi River is shifted far into the western half of the cartogram. For the purpose of more detailed studies, the regions are subdivided

into states, and our greatest metropolitan districts are also shown in proper proportions.

For an economist, a cartogram made proportional to the national wealth is useful. Figure 3 is very similar to the population cartogram, the main difference being a further reduction of the size of the South,

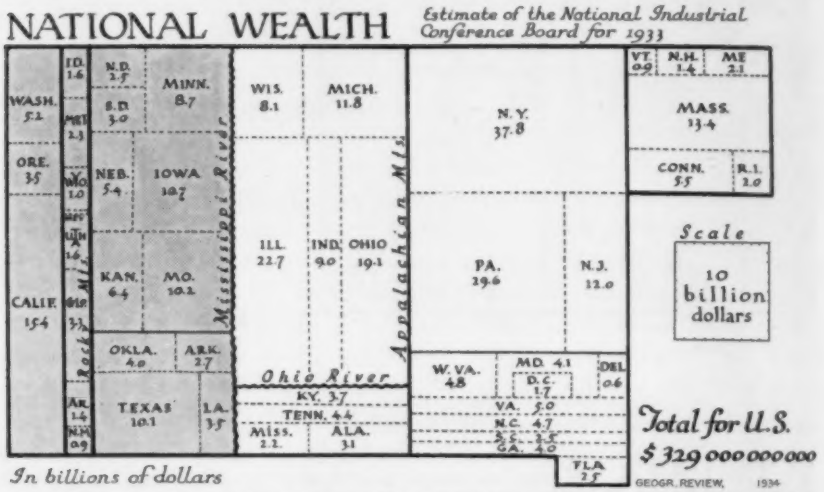

FIG. 3—Rectangular statistical cartogram with rectangles proportionate to the national wealth as distributed among the states. Note the similarity, except in the South, to the cartogram of population, Figure 2.

the big negro population of which is a lesser producer than the western ranchers. The position of the Ohio River should be noted.

Figure 4 shows the distribution of the main lines of economic production in the United States—manufacturing, farming, and mining—in separate cartograms on a uniform scale. The cartograms represent 1929 values because only those were available, so their absolute value is out of date at present, but the relative proportions have changed little. Many interesting facts can be read from these cartograms. It may be somewhat of a surprise to see that the manufacturing of New York state is worth almost the same as all manufacturing west of the Mississippi River and that the farming of one of our greatest farming states, Iowa, does not exceed in value the manufacturing of so recently industrialized a state as North Carolina. A comparison of the proportions of the mineral wealth of our western states and the coal of Pennsylvania is also illuminating.

EDUCATIONAL AND ECONOMIC VALUE

The purpose of the rectangular statistical cartogram is twofold—for educational uses and for the facilitation of business planning. Its educational value is not limited to the schools: it may serve to set

right common misconceptions held by even well informed people as to the importance of the various parts of the United States.

It is hard to escape the question whether or not division of the western mountains and plateaus among seven states is justified when

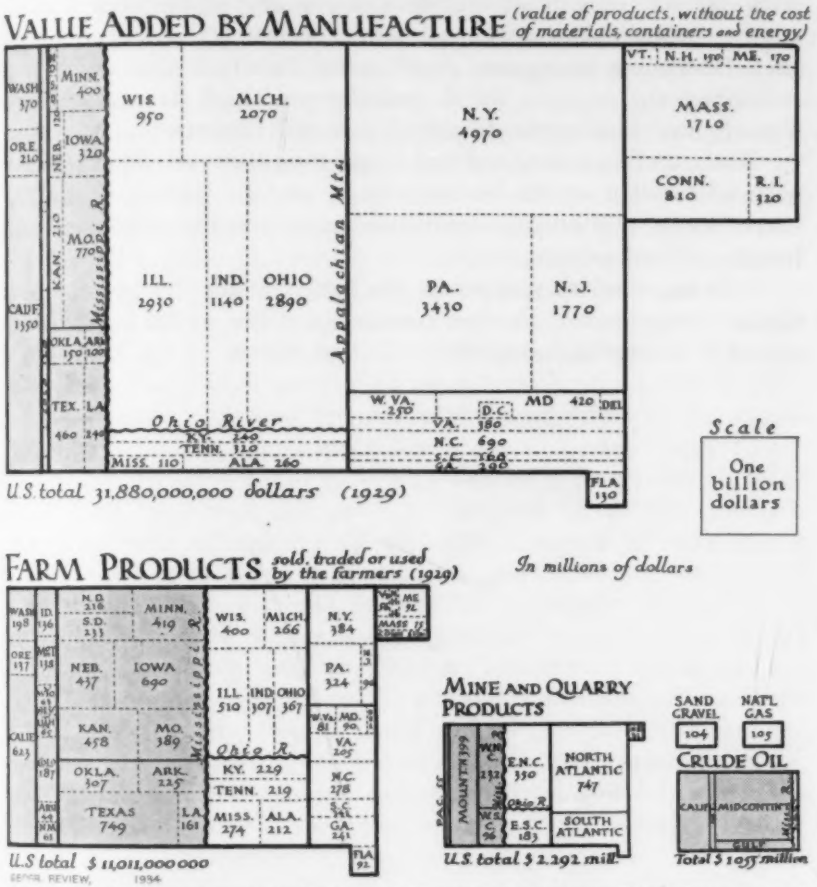

FIG. 4—Statistical cartograms showing the main lines of production in the United States on a uniform scale. Note the concentration of manufacturing in the northeast and the more even distribution of farming activities. The figures are taken from the Fifteenth Census of the United States and represent values of 1929.

one sees so clearly what an insignificant portion of the country, for instance, is represented by the senators of Nevada. Surely it would be a good thing if our political leaders in Washington always had before them a clear picture of the relative values of farming and manufacturing, the relative economic importance of East and West, and the like.

For business planning, cartograms of this type can be used in various ways. The management of a nation-wide chain store wanting to show the location of its branches, business districts, and sales districts

will have difficulty in doing so on an ordinary map. The New York district will probably have more stores than several states in the West, as chain stores are located according to population rather than according to area. There will be no difficulty, however, in putting the pins with colored heads in a population cartogram and discovering blank spots or overcrowded areas. It would be instructive to prepare for each business a cartogram showing the distribution in which it is interested; for example, for a company producing dairy machinery, a cartogram showing the distribution of milk production.

Banks and insurance and real-estate companies will find the cartogram of national wealth correspondingly useful. Nation-wide educational, social, and religious institutions may also map their activities intelligently on a cartogram.

It is expected to prepare in the future similar rectangular statistical cartograms of Europe, America, and the world, and of other economic and social factors in the United States.

SUBMARINE MOCK VALLEYS

W. M. Davis

THOSE peculiar features found in the sea floors of continental margins and generally known as "submarine valleys" have been confidently interpreted by a number of geologists as the product of streaming and weathering during a recent epoch of emergence and as not yet obliterated by marine deposition during a still more recent time of submergence.[1] It is not intended to imply by what here follows that the method of submarine-valley formation thus outlined is either impossible or non-operative. The object of this essay is to point out certain difficulties in the way of the general acceptance of that method, thus supplementing the writings of several authors cited below, and at the same time to suggest the consideration of other methods for the production of submarine valleys. It is desired also to urge the maintenance of an open mind on the problem, inasmuch as certain collateral but essential consequences of the above-outlined method of submarine-valley production have not yet been verified; indeed, have not even been considered in the writings of some of its more convinced advocates. Nor have alternative methods been given the hospitable and thorough discussion that Chamberlin has so well shown to be essential in impartial and decisive investigation.[2]

A submarine valley should be regarded as merely an element in the geological history of its coastal region, and its explanation should therefore be consistent with that history. Moreover, the larger part of the history must be based on the study of the visible surface of the coastal land area, the form of which can be accurately mapped, the structure of which can be fairly well inferred from surface outcrops, and the internal and external processes affecting which are fairly well understood; while the sea floor is, as a rule, imperfectly charted, its structure is unknown except for a veneer of surface sediments, and its processes are still uncertain.

Submarine Mock Valleys of the Santa Monica Coast

In connection with a study of the coastal development of the Santa Monica Mountains in southern California my attention has

[1] A variant of this interpretation recently proposed by Francis P. Shepard is to the effect that the valleys were eroded during a more ancient epoch of emergence, then filled and obliterated by the deposition of marine sediments during a sufficiently long period of submergence, and lately revealed again by the downsliding of the sedimentary filling to greater depths. See his article "Landslide-Modifications of Submarine Valleys," *Trans. Amer. Geophys. Union, Thirteenth Ann. Meeting, April 28 and 29, 1932*, Washington, 1932, pp. 226–230. The same author has given an excellent summary of various hypotheses for the explanation of these features in "Submarine Valleys," *Geogr. Rev.*, Vol. 23, 1933, pp. 77–89.

[2] T. C. Chamberlin: The Method of Multiple Working Hypotheses, *Journ. of Geol.*, Vol. 5, 1897, pp. 837–848.

recently been directed to a stretch of the southern Californian sea floor where discovery has been made of three lowerings and depositional withdrawals of the sea alternating with four rises and abrasional advances, which I believe were causally associated with as many glacial and nonglacial epochs of Pleistocene time. It was there found that during the last epoch (probably during the last two epochs) of lowered sea level a number of the mountain streams eroded their valleys to a moderate depth below present sea level and for a moderate distance forward from the mountains across a belt of weak Miocene beds—a belt that had been faulted down along the southern mountain border and that then constituted a lowland plain but is now the near-shore part of the sea floor. But it was also found that the parts of those valleys now below sea level had been completely obliterated by marine deposition during the postglacial rise of sea level to the present shore line at the base of the abraded mountain cliffs.[3]

The sea floor in the neighborhood of the mountains nevertheless possesses, as has been shown by Davidson, several well defined submarine valleys, one of which, lying about 10 miles west of the mountains off the Hueneme beach of the Oxnard plain, is of interest as being the first discovered example of its kind on the Californian coast.[4] But all these valleys are continued in Davidson's contours to depths of 200 or 300 fathoms, which is from 3 to 6 times deeper than the estimate adopted by Daly for the Glacial lowering of sea level.[5]

There are, therefore, two points to be noted regarding the submarine valleys of the Santa Monica coast. The first point is that no evidence is found in the mountains to indicate a recent upheaval and subsidence by any such measure as 1200 or 1800 feet. Hence the valleys there charted by Davidson are far below the reach of erosional production during any known epoch of coastal emergence. Hoots states that the first deformation of the mountain rocks was of mid-Miocene date; that after suffering erosional reduction to low relief in later Tertiary time the worn-down mass was broadly uplifted 2000 or 3000 feet to its present altitude near the end of Pleistocene time; and that during and since that uplift the resulting highland has been submaturely dissected.[6] It may be pointed out in this connection that the belt of weak Miocene beds, alluded to above as bordering

[3] W. M. Davis: Glacial Epochs of the Santa Monica Mountains, California, *Bull. Geol. Soc. of America*, Vol. 44, 1933, pp. 1041–1133.

[4] George Davidson: The Submerged Valleys of the Coast of California, U. S. A., and of Lower California, Mexico, *Proc. California Acad. of Sci.*, 3rd Ser. (Geology), Vol. 1, 1897–1904, pp. 73–103. It is noteworthy that this experienced hydrographer first called these features "submarine valleys" but later designated them as "submerged valleys." He did not explicitly state them to be the work of streams during a former emergence of the sea floor, apparently because that origin was in his opinion too manifest to need statement, for he wrote: "The first discovery of a distinct valley in the submerged surface of the earth bordering the coast of California was made in 1855 by the U. S. Coast Survey."

[5] R. A. Daly: Swinging Sealevel of the Ice Age, *Bull. Geol. Soc. of America*, Vol. 40, 1929, pp. 721–734.

[6] H. W. Hoots: Geology of the Eastern Part of the Santa Monica Mountains, Los Angeles County, California, *U. S. Geol. Survey Professional Paper 165-C*, 1931.

the mountains on the south, was conceivably faulted down after having been previously uplifted with the mountain mass and that the valleys that had been eroded across the belt during its existence as an upland were submerged by the downfaulting. But in that case there should now be as many submerged valleys as there are good-sized mountain streams, and there are not. Only one submerged valley is found that might possibly be of this origin, and there should be at least ten or twelve. Moreover, the Hueneme submerged valley fronts the Oxnard plain, which appears not to have suffered uplift with the mountains but to have long been the site of subsidence. Hence this explanatory scheme is inapplicable.

The second point is that ordinary depositional processes, which have unquestionably been acting to build up the shallower sea floor adjoining the submarine valleys, ought to have obliterated the inner parts at least of the existing submarine valleys, unless some marine process of opposite nature and still in operation had kept them empty. Hence, in view of the great improbability that the submarine valleys off the Santa Monica coast are truly valleys of subaerial erosion, I propose to call them submarine mock valleys.

Views of Earlier Observers

The foregoing conclusions, to which I was led by local study, substantially repeat the conclusions reached for this coast about 30 years ago by Ritter and Tangier Smith, to whose brief articles my attention has recently been directed. Ritter dredged in the Vincente (or Redondo) submarine valley, which lies some fifteen miles south of the Santa Monica coast, and he was there led to the belief that inshore material is carried into that valley in large quantities and that such "valleys are natural channels through which currents flow, at times at least, *from the shore out to deeper water*."[7] Tangier Smith, quoting Ritter, gave a well reasoned general discussion of the problem, showing sound reasons for doubting the commonly accepted method of submarine-valley production above outlined, and concluding that "the majority of the submarine channels of the California coast have been formed, or are at least kept open, by some cause now in operation."[8]

Ten years earlier Dana had already made a protest against the too facile acceptance of a subaerial origin for one of the most famous of all submarine valleys, that of the Hudson River. He wrote: "It may be that the outflowing tide from New York Bay and from the adjoining parts of the shores of Long Island and New Jersey may have combined their forces along a diagonal line crossing the shallow

[7] W. E. Ritter: A Summer's Dredging on the Coast of Southern California, *Science*, Vol. 15 (N.S.), 1902, pp. 55–65; reference on p. 59.

[8] W. S. Tangier Smith: The Submarine Valleys of the California Coast, *Science*, Vol. 15 (N.S.), 1902, pp. 670–672; reference on p. 670.

Atlantic border region, and, by scour only, have given the existing depth as well as course to the larger part of the channel."[9] Oceanographers have not given sufficient heed to this suggestion.

It has been pointed out by Trask that the Hueneme submarine valley referred to above is floored with fine sediment;[10] and the presence of such sediment might be appealed to as showing that no submarine agency capable of preventing deposition is in operation there. But it may also be argued that, if the agency of prevention is an outflowing bottom current, effective chiefly during great storms, fine sediments of the kind that are then swept away would be redeposited during a following spell of fine weather, when soundings are usually made. The case would be analogous to that of a river, which scours away the sediments of its bed while in flood but lays down similar sediments again as the flood subsides; or to that of shore waves, which in calm weather play about on beaches, the detritus of which they lift and shift during storms; or to that of water erosion in the desert, which is inoperative for years of no rainfall but which becomes violently active for a few hours after a cloud-burst.

Localization of Sea-floor Currents

As to the possibility of localizing a submarine current sufficiently to enable it to prevent deposition or even to accomplish some erosional excavation along a relatively narrow trough, it may be noted that the four best defined mock valleys—Hueneme, Mugu, Point Dume, and Vincente (or Redondo)—of the Santa Monica region shown on Davidson's Chart VI are all associated with irregularities of the present shore. The first two are near pronounced southeastward inturns of a mile in the heavy sand beach of the Oxnard plain, and these inturns indicate the prevalence of a dominant southeastward longshore current, the presence of which is shown also by the direction of beach drift. It may therefore be inferred that a backset eddy current, frictionally driven by, and therefore in gear with, the main shore current, is there located; and it should be further inferred that such an eddy current may interfere with the main current sufficiently to compel it to give off a slow outflowing bottom current. The fact that the two mock valleys here considered do not agree precisely in position with the beach inturns may perhaps be explained by a shift of the inturns in the direction of the main current, such as is well known to take place; while the mock valleys, once begun, are likely to retain their position. This hypothesis is offered merely as a tentative suggestion; but it is of the kind that should, I believe, be made in searching

[9] J. D. Dana: Long Island Sound in the Quaternary Era, with Observations on the Submarine Hudson River Channel, *Amer. Journ. of Sci.*, Ser. 3, Vol. 40, 1890, pp. 425–437; reference on p. 432.

[10] P. D. Trask: Origin and Environment of Source Sediments of Petroleum, Houston, Tex., 1932, pp. 90 and 122.

for the recondite cause of these singular submarine features. The difficulty remains of testing its verity and sufficiency.

The other two mock valleys—Point Dume and Vincente—here under consideration are on the up-current side of pronounced salients of the coast: one of these is Point Dume, which stands forth two miles from the general shore line of the Santa Monica Mountains at the mid-length of their coast; the other is the large fault-block promontory of San Pedro, some twenty miles south of the mountains. It may be inferred that these coastal salients localize outflowing sea-floor currents that are deflected from the dominant surface current; also, that when accelerated at time of violent storms such deflected sea-floor currents are capable of drifting large quantities of inshore detritus seaward along their trough, as Ritter announced.

The Value of Outrageous Theories

If any of these inferences seem outrageously improbable at first reading, let the grounds for their outrageousness be deliberately inquired into; and, when they are found, let the necessity of believing them be seriously questioned. What at first appears outrageous may, when those grounds are deep-plowed, possibly come to be regarded as "intrageous"; and the more deeply they are plowed the more reasonably "intrageous" the outrageous inferences may come to appear.[11] Consideration should thus be given not only to the apparently fantastic idea of localized outflowing sea-floor currents, chiefly active during storms, but to all other inventible agencies that come forth when the imagination is ransacked for them. Each invented agency should be carefully scrutinized as to its availability before we fall back on anything so outrageous as the recent upheaval of our littoral sea floors through any such measures as 2000, 5000, or even 12,000 feet, which some submarine mock valleys demand on the theory that they represent normal valleys of subaerial erosion.

Surely it ought not to be necessary today to repeat that the replacement of previously accepted conclusions by new conclusions, which at the time of their proposal were almost universally regarded as outrageous, has long marked the course of scientific progress. Witness our now accepted beliefs about the rotation of the earth, its revolution around the sun, its great age, the antiquity of man, the evolution of life forms, and the recent glaciation of large continental areas. And, if it is objected that earth science is now so well established that no outrageous modifications of its generally accepted conclusions are to be expected, let it be seriously asked whether submarine processes deserve to be so considered.

[11] See an essay by the author on "The Value of Outrageous Geological Hypotheses," *Science*, Vol. 63 (N.S.), 1926, pp. 463–468.

Are we justified, for example, in rejecting a slow process of submarine erosion by which mock valleys could actually be excavated in the slopes of the sea floor? May not the rocks in certain parts of the submarine continental slopes be slowly disintegrated by the high-pressure sea water? May not an outflowing sea-floor current, branching from a surface current because of some peculiarity of coastal configuration and accelerated during surface storms, be competent to remove the leached slime from rocks thus disintegrated? Would such action be more remarkable than the removal of silica from decomposed feldspar in rain-water solution during the production of laterite on subaerial peneplains, the degradation of which requires hundreds of thousands of years? If such submarine erosion (or "marosion," as it might be called) is possible at all, might it not, in the course of a geological period, produce significant changes of sea-floor configuration? These are some of the outrageous possibilities that call for investigation.

A Remarkable Example of Submarine Degradation

This section is given to an example of submarine degradation at a surprising depth off the northeastern coast of Australia. The facts concerned came to my notice through the writings of Alexander Agassiz, the most widely experienced observer of coral reefs the world has known, and of Charles Hedley, expert biological and geological observer of the Australian coast.

Agassiz wrote as follows: "It is a curious coincidence . . . that at Breaksea Spit [near the southern end of the Great Barrier Reef of Australia], as well as at Cape Florida [the northern end of the Key West coral reefs], we should find the encroachment of the silicious sands, in one case coming from the north along the [sand reefs on the eastern] coast of Florida, and in the other coming from the south along the shores of [the sand reef that constitutes] Frazer Island [on the coast of Queensland, Australia], gradually prevent the farther northern and southern extension of coral reefs in the two regions. . . . It is evident that the corals upon the spit are dead, and that they probably have been killed by the encroachment of the silicious sands creeping northward . . . This silicious sand is constantly overwhelming the few corals which manage to get established on the spit, and prevent their further growth, much as the silicious sands of Cape Florida are constantly mixing with the calcareous sand derived from the coral reefs immediately to the south of it."[12] In other words, the poleward extension of the Australian and Floridian coral reefs is prevented by the equatorward drift of sand from adjacent sand reefs.

[12] Alexander Agassiz: A Visit to the Great Barrier Reef of Australia in the Steamer "Croydon," during April and May, 1896, *Bull. Museum of Comp. Zoöl. at Harvard College*, Vol. 28 (Geol. Ser., Vol. 3), 1895–1898, pp. 93–148; reference on pp. 104–105.

About 15 years after Agassiz's visit to Australia Hedley called attention to a remarkable increase in the depth of the sea floor in the neighborhood of the above-mentioned Breaksea Spit, over an area of more than 100 square miles, as shown by the consistent differences between soundings taken by two British surveying ships, the first about 1869, the second in 1904. The captain of the second vessel "found that from five to ten miles north of Break-Sea Spit the conformation of the sea-floor had entirely altered during the thirty-four years that had elapsed since the previous survey. Where his predecessors had found twenty to thirty fathoms he measured from two to three hundred fathoms." The captain ascribed the alteration of depth to excavation by "a powerful southerly-going current," thus failing to note that a current in that direction would carry calcareous sand southward, instead of carrying siliceous sand northward, as Agassiz states is the case; but Hedley was inclined to ascribe the deepening to a movement of the earth's crust, although, as he noted that no accompanying change had taken place in the shore line, this explanation must have seemed doubtful.[13]

It thus appears that Agassiz found that the sands, drifting northward, were smothering the corals at the end of the Great Barrier Reef but that he had no knowledge of the deepening of the adjacent sea floor, which had not been discovered at the time of his visit. Hedley, on the contrary, knew of the sea-floor deepening but did not associate it with the smothering of the corals at the reef end, although he noted that "conditions are really becoming very adverse for coral growth" thereabouts. But when the two groups of facts are considered together it is difficult not to associate them in the relation of cause and effect. It seems reasonable to suggest that, as long as corals and other reef builders thrive, the reef that they build will assume a submarine profile appropriate, on the one hand, to the constructive rate at which they contribute their calcareous skeletons to its building and, on the other hand, to the destructive rate at which the local waves and currents wear the reef away. But as soon as the reef builders are killed the destructive waves and currents will have it all their own way, and a change toward a submarine profile of their preference will go on apace.

It seems probable that an encroachment of this kind, by which sand reef has gained on coral reef, has been going on for a considerable part of postglacial time and that a large part of the 400-mile failure of the Great Barrier Reef to reach the southern limit of the coral seas is to be thus accounted for. It is, indeed, conceivable that a much greater encroachment of the same kind was accomplished during the last interglacial epoch, which was much longer than postglacial time,

[13] C. Hedley: A Study of Marginal Drainage, *Proc. Linnean Soc. of New South Wales*, Vol. 36, 1911, pp. 13–39; reference on p. 17.

and also that the siliceous sands found by a recent boring through the Great Barrier a good distance north of Breaksea Spit may be thus accounted for. This suggestion, it may be noted in passing, illustrates the complexities reached by the geological aspects of the coral-reef problem—complexities seldom taken into consideration by its zoölogical students.

However, both the pace at which the change has recently gone on in this instance and the depth to which it has reached are astonishing, so I wrote to the British Admiralty in London, asking whether the two sets of soundings in question could be accepted as trustworthy, and was assured in reply that they could be so considered. This instance of rapid and deep submarine degradation would seem to be the greatest authentic example of its kind. Before accepting it as a finality, however, it may be prudent to wait confirmation by a third set of soundings, which should show a northward extension of the previously discovered deepening, if the explanation here suggested is correct. Even if such changes in depth are excessive, changes of much slower rate have had plenty of time for the production of important modifications in the course of a geological period or epoch.

The moral of this story, as applied to submarine valleys, is clear. We must believe not only that efficient processes of degradation and transportation are at work on the sea floor at considerable depths but also that they will strive to modify sea-floor profiles enforced upon them by other agencies, such as crustal deformation, volcanic eruptions, deposition of clastic material from the lands, or reef building, and to reshape them either by degradation or by prevention of deposition.

The Monterey Mock Valley

The most remarkable submarine mock valley of the California coast is that heading in Monterey Bay, 70 miles south of Golden Gate. The progress of our knowledge concerning this valley is instructive. Its near-shore part was first contoured in 1897 on Davidson's Plate IX, where it is shown for about 18 miles offshore down to 800 fathoms, but the deeper contours along its southern side are there drawn on insufficient evidence, having been guided much more by theoretical preconceptions than by charted soundings.

Seventeen years later the valley was adventurously shown in suspiciously regular contour lines for every 100 meters down to 3200 meters (about 1700 fathoms) 70 miles offshore on the San Francisco Bay sheet of the projected map of North America on a scale of 1 : 1,000,000 published by the U. S. Geological Survey; but the deeper contours must be largely imaginary because of lack of soundings then available to control them.

A noteworthy advance would seem to have been accomplished by

the extended series of echo soundings made by the United States cruisers *Hull* and *Corry* in 1922 along the southern half of the California coast, the contoured depths thus determined being published by the U. S. Hydrographic Office on a colored chart (5194) in 1923: here the valley is shown down to 2000 fathoms about 65 miles offshore; but, as the location of the individual soundings is unfortunately not indicated on this chart, the trustworthiness of the contours cannot be judged.[14] As far as Monterey Bay region alone is concerned, the configuration of the sea floor as determined by these echo soundings can be best studied on a special edition of Coast Survey chart 5402, issued by the Hydrographic Office, on which the position of the echo soundings and their contours is overprinted.[15]

The latest representation of the Monterey mock valley is on a detailed but as yet unpublished chart, showing a great number of accurately measured and located soundings (but not covering the inner part of the bay, which had previously been surveyed with sufficient accuracy), made by the Coast and Geodetic Survey in 1932, a copy of which has been generously sent me by the Director of that bureau. Here a well defined and noticeably sigmoid trough is shown with several short branches in its upper part and with a line of continuous descent from a depth of 500 fathoms at a distance of 15 nautical miles from the valley head near the shore down to 1900 fathoms at a distance of about 65 miles from the same point. The sea bottom at the lower end of the trough is not noticeably uneven; it certainly exhibits no back-slope basins and no huge sprawling mounds such as should be produced by a landslide of dimensions sufficient to empty the trough behind it.

[14] It is regrettable also that the soundings made by the two cruisers were not corrected for their obliquity due to the slope of the sea floor, which in certain localities appears to be so great as to cause errors of about 12 per cent of the true depth, as well as significant errors of position. (See A. L. Shalowitz: Slope Corrections for Echo Soundings, *U. S. Coast and Geodetic Survey Special Publ. No. 165*, 1930.) Moreover, the contours for the chart were not drawn by a hydrographer but by a topographer of the U. S. Geological Survey, who was presumably more familiar with the forms of the lands than with those of the sea floor. And, inasmuch as a certain rectangular area of over 1800 square nautical miles in the deeper part of the valley has, apart from the soundings along its two longer sides, not a single indication of depth, the contours there drawn cannot be regarded as well certified, although they are given the same strength as elsewhere.

[15] A study of this chart is, however, somewhat perplexing, for it seems to show that earlier soundings by the Coast Survey, printed in smaller figures, were not utilized in drawing the contours here shown. For example, at one point, near which 5 Coast Survey soundings are platted, the H. O. contour of 200 fathoms runs close to a C. S. sounding of 455 fathoms; and at another point the H. O. contour of 600 fathoms runs near a C. S. sounding of 320 fathoms. More disconcerting still is the discordance between the *Hull* and *Corry* soundings, taken every mile on lines 10 miles apart square to the coast, and a later line of echo soundings run by the U. S. SS. *Maryland* in 1929, but on a line parallel to the coast, all these soundings being printed as if equally authentic. At one point where two lines of soundings cross about 25 miles southwest of Monterey, the earlier line consistently gives 850, 990, 1070, 1175, and 1360 fathoms, while the later line gives with equal consistency 600, 600, 670, 690, and 795. Here the middle soundings of both series are only half a mile apart, yet they differ from each other by an even 400 fathoms. A letter from the Hydrographic Office informs me that these discrepancies "can be best accounted for by probable errors in the ship's [*Maryland*] positions and incorrect depth values (the sonic values not corrected for velocity of sound in differing densities of water or for slope of bottom). The fixes for the lines of soundings taken by the *Maryland* while cruising along the coast, out of sight of land, and in thick weather, are not considered as reliable as those of the *Hull* and *Corry*."

The trough is thus definitely shown to be a large and important feature of the continental slope. The confirmation of its existence given by these numerous and accurately located soundings must, indeed, be a satisfaction to those who had contoured it on earlier charts of fewer soundings; but so great is the irregularity of the latest and best contours that it is rather difficult to identify certain features previously shown by simpler contours. This suggests a point of importance: if the true explanation of a submarine valley depends on a fairly close knowledge of its form, very few of the deeper ones can be today considered well enough known to serve as a basis of study.

Requirements for Subaerial Erosion

If the Monterey mock valley is explained as a normal valley of subaerial erosion, two contrasted suppositions may be made as to the manner in which the submarine continental slope was temporarily upheaved. First, the upheaval may have involved little more than an upbending of the slope itself on a hinge line along the shore, without any equivalent upheaval of the present land area. In this case no great deepening of the land valleys would be needed, but the river that then eroded the valley would have had to maintain its course across the upbent offshore belt, and the upbending would therefore have to be slow. It would furthermore have to be rather long maintained, because the submarine trough that now exists there is broadly opened. But it is to be questioned whether any structural geologist will accept this strong though simple up-and-down style of deformation of a submarine belt alongside of an undisturbed land belt.

Second, the upheaval may have involved a fairly uniform elevation of a large coastal region, followed by a corresponding regional subsidence. In this case an immense deepening of the present land valleys, which mouth in the bay, along a good number of miles of their lower courses would result, if the upheaval were maintained long enough for the deepening and broadening of the now submarine part of the valley, and a correspondingly great refilling of the deepened land valleys would follow the regional subsidence of the land to its present level. The valley of the Salinas River, which enters Monterey Bay from an aggraded valley on the southeast, may have suffered some such changes; but that of the Pajaro River, which enters farther north from a narrow valley through the end of the mountains that limit the northern side of the bay, gives no indication of having been thus deepened and refilled.

Geological History of Monterey Bay

Instead of assuming coastal upheaval, erosion, and subsidence, let another assumption be made more consistent with what is known

of the diastrophic history of the region. Let it be understood at the outset that Monterey Bay is not a drowned valley of subaerial erosion, like the beautiful branching bay of Port Jackson, New South Wales, on which Sydney stands. Monterey Bay is best explained as occupying the unfilled part of a gulf that took possession of a depressed land area, adjoining which on the north, east, and south the mountain ranges of today were individually uplifted in late geological time, after their predecessors had been worn down to moderate or low relief.[16] The area of gulf depression was probably a land area of similarly worn-down surface before it was depressed.

Since their upheaval the coastal mountain ranges have been liberally dissected, and their outwashed detritus, along with much more that was brought from other ranges farther inland by the Pajaro and Salinas rivers, has been swept into the gulf of depression, thus filling up the inner part and converting it into a low plain, but leaving the outer part, less filled, as the existing bay. Hence, it is not to be expected that the submarine slope of the bay should still exhibit any close imitation of the form given to it by the depression of the former land surface.[17] The slopes of depression must have been much built up by the inwashed sediments, which should have, during their accumulation, assumed a form determined by the movements of the sea water, either in general drifts or in more localized currents, both of which may have been spurred to greatest activity during severe storms. And be it noted that the form of the bay is admirably adapted to the development of an outgoing bottom current to compensate for an inward drift of the surface waters under the action of severe onshore winds.[18] It is possible that the shore waters, made turbid at such times by wave action, would thus gain an increased specific gravity that would facilitate their descent into the colder water of the depths.

This explanation is at present altogether hypothetical for the greater length of the Monterey mock valley, but it is almost demonstrably true for the inner two or three miles, which are well shown as to form, depth, and deposits on Galliher's admirable lithologic map of the bay, based on a U. S. Coast and Geodetic Survey chart.[19] This short innermost part of the 65-mile mock valley is narrow, steep-sided, and well defined, as shown by 5-fathom contours to a depth of

[16] Robin Willis: Physiography of the California Coast Ranges, *Bull. Geol. Soc. of America*, Vol. 36, 1925, pp. 641–678.

[17] A. C. Lawson briefly suggested 40 years ago that the Monterey submarine valley is a trough of deformation, but he did not give special consideration to its modification by postdeformational deposition. See "The Geology of Carmelo Bay," *Univ. of California Publs. in Geol.*, Vol. 1, 1893–1896, pp. 1–59.

[18] The action of such a bottom current has been appealed to by Bailey Willis in explanation of a submarine valley below the east coast of the Mediterranean island of Cyprus. See his letter on "A Submarine Trough off the Coast of Cyprus," *Geogr. Journ.*, Vol. 79, 1932, pp. 349–351.

[19] E. W. Galliher: Sediments of Monterey Bay, California, *Mining in California*, Vol. 28, 1932, pp. 42–79.

50 fathoms. Its depth is less than 100 fathoms, and it is bordered by a smooth and shallower sea floor, which slopes gradually from the shore to about 30 fathoms. It is inconceivable that such a feature could have been kept open without the aid of a storm-driven, outsweeping current during the last Glacial lowering and rising of sea level. Even today the shore drift would fill up the head, unless, as Tangier Smith well said, the valley has "been formed, or at least kept open, by some cause now in operation." Indeed, if minutely accurate surveys of the valley head could be made, it would probably be found to be somewhat longer and deeper during stormy winters and shorter and shallower during the fine weather of summers.

The fact that the valley head, as well as the adjoining shallower sea floor, is shown on Galliher's map to be covered with "very fine sand," as determined by fair-weather dredging, does not militate in the least against the temporary action of such a localized bottom current as is here inferred; for fine sediments might be swept away whenever a fairly active, storm-driven bottom current is at work, only to be replaced by similar sediments when the current weakens or comes to rest. Other significant features of sediment distribution are shown on the map, but their explanation had best be left to those who observed and charted them.

It is only by individual study of many submarine valleys in close connection with the geological history of their coast that their origin can be determined; and when thus determined it is highly probable that they will be found to have many diverse and somewhat complicated origins. This paper is offered as a small contribution to such individual study.

THIRTIETH ANNUAL MEETING OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS

THE Association of American Geographers met at Evanston, Ill., on December 26, 27, and 28, 1933, for its thirtieth annual meeting. The sessions were held in Harris Hall of Northwestern University, with Mr. François Matthes, of the U. S. Geological Survey, President of the Association for 1933, in the chair. Excellent arrangements had been made by the Department of Geology and Geography under the chairmanship of Professor W. H. Haas. In Harris Hall there was an exhibit of wall maps, atlases, etc. by educational map publishers and an interesting display by Colonel Lawrence Martin of a series of reimpressions of one of Delisle's maps of North America which, because of the repetition of the original date of publication on later reprints extending through a period of nearly 90 years, illustrated one of the pitfalls of cartographic chronology. Other centers of interest were the departmental library in University Hall and the new, admirably equipped Deering Library of Northwestern University. A special display of historical maps from the Edward E. Ayer Americana collection in the Newberry Library of Chicago had been arranged by the librarian, Mr. George B. Utley, former president of the Geographic Society of Chicago. Opportunity was offered to visit the Adler Planetarium in Chicago; the proposed field trip to study the physiography of the region northwest of Evanston had to be abandoned because of the snowfall and subsequent cold wave.

Announcement was made of the election of the following officers for 1934: Wallace W. Atwood, president; V. C. Finch, vice-president; R. S. Platt, treasurer; F. E. Williams, secretary; Preston E. James, councilor for three years.

About fifty papers, including the presidential address, were read, twenty of which were "introduced" papers by nonmembers. The large proportion of introduced papers on the program in recent years, which is welcome evidence of the continued growth of university departments of geography, has led to a tendency to group them by themselves. While this facilitates the legitimate conservation of the priority rights of members in case of an overcrowded program, the hope may be expressed that, within the necessary limitations, it may prove possible to group more closely together the papers, by members and nonmembers, dealing with related topics or the same general region. The common interest of those of the members concerned with the regional geography of the same continental unit found natural expression, it may be stated here, in the informal organization at this meeting, for the interchange of information as to research under way and planned, of groups of those who specialize respectively in South America, Asia, and Europe.

At one of the sessions an announcement was made with regard to the forthcoming International Geographical Congress at Warsaw (see pp. 335–336) and the desirability of American attendance was stressed.

Symposium on Terminology and Regional Presentation

As at previous meetings, the outstanding part of the program was that which was devoted to the discussion of a single major theme by means of a number of well chosen solicited papers. The theme, announced as "Conventionalizing Geographic Investigation and Presentation," was dealt with in three papers of about twenty minutes' length each, followed by a discussion launched by a prepared speaker. The three papers were "The Terminology of Regional Description" by Preston E. James (discussion launched by R. H. Whitbeck), "Procedures in Regional Investigation" by Wellington D. Jones (discussion launched by Stanley D. Dodge), and "Written Structures for Presenting the Geography of Regions" by V. C. Finch (discussion

launched by Samuel Dicken). A related paper by W. H. Haas, "Foundations and Limits in Geography," read earlier in the program may be mentioned in this connection.

TERMINOLOGY OF REGIONAL DESCRIPTION

Professor James pointed out that, in any science, the need for technical terms arises from the development of new concepts, to express which either newly coined words or new meanings of existing words are required. As concepts are therefore the fundamental elements, he dealt primarily with these and only to a secondary degree with the symbols that express these concepts.

The outstanding part of his address discussed the question of scale in regional presentation as conditioned by the size of the area investigated and set forth the rôle of generalization in such presentation. His exposition should help clarify the confusion that has reigned in some quarters (see *Geogr. Rev.*, Vol. 17, 1927, p. 310). Not until we generalize the details of an intensive study of a small area do we see the larger pattern of distribution, the major lineaments of the face of the earth, whose recognition, after all, is the geographer's primary objective. To many the word "generalization" connotes superficiality. There are many examples of superficial studies, but the superficiality is due to inadequate or hasty generalization. The principles of all sciences consist of generalizations, constantly being refined, which draw attention to broad similarities and neglect detailed differences. The general design of the face of the earth is just as real as the more specific reality of the small area. "The detailed study of the small area becomes significant in so far as it contributes to the more accurate generalization of this detail" on general maps of regional or continental scope; "and the larger patterns themselves become more than superficial only to the extent that they are based on detailed distributions."

Although geographic generalization can be effected at an almost infinite number of different scales, Professor James suggested that, broadly, three orders of generalization may conveniently be recognized. These would apply to the three sizes of areas implied immediately above, viz. a small area (such as Finch's Montfort area), a region (such as Baker's agricultural regions of North America), and a continent or the world. Reverting to their original derivation, he would use the terms *topographic*, *chorographic*, and *geographic*, respectively, for studies of these units. The fact that "topographic" (and its noun) has acquired a specialized meaning he considers no objection to using it in its original sense in a technical classification such as this. To circumvent all difficulties, however, it was suggested in the discussion that followed the reading of the paper that the three types of areas be termed *microchore*, *mesochore*, and *macrochore* (with their corresponding adjectives *microchoric*, etc.).

Another question discussed in the paper was the study and comparison of distribution patterns in a given area, a study that the speaker stated may well entitle geography to recognition as an exact science. To suggest the possible direction in which the development of the as yet undeveloped terminology of this phase of geography may proceed, Professor James showed three diagrams illustrating the three essentially different ways in which the distributional patterns of two elements coexisting in an area may be related to each other. In the first case the two elements occupy the same area, and one may speak of their coincidence, involving what is probably a causal relationship; in the second, they do not occupy exactly the same area, but their patterns bear a strong resemblance, and one may speak of their correspondence and partial correlation; in the third case the patterns show no similarity, and the relationship may be described as discordance.

Finally, Professor James's paper dealt with new terms, or old terms with new meanings, already introduced. These included *landscape* (introduced by Sauer: The Morphology of Landscape, *Univ. of California Publs. in Geogr.*, Vol. 2, pp. 19–53.

1925) in the sense of a portion of territory which is found to exhibit essentially the same aspect after it has been examined from any necessary number of views; *fundament* (introduced by Leighly), the terrestrial foundation on which the works of man have been built; *cultural landscape*, the fundament as modified by man and his works; *occupance* and the variant *occupancy* (introduced by Whittlesey, *Annals Assn. of Amer. Geogrs.*, Vol. 19, 1929, pp. 55–56; R. S. Platt, *ibid.*, p. 43; and others), the process of man's entering and living in an area and the transformation of the original landscape that results therefrom; *sequent occupance* (introduced by Whittlesey, *Annals Assn. of Amer. Geogrs.*, Vol. 19, 1929, pp. 162–165), the sequence of cultures and "cultural impresses" (suggested by Whitbeck) that have created a complex of superimposed occupance patterns in any given area.

PROCEDURES IN REGIONAL INVESTIGATION

Professor Jones pointed out that the procedure of any investigation should be carried out in the light of the objective of that investigation. In a regional investigation, he stated, the objective might be considered to be to acquire and set forth an organized understanding of the human use of regions. A regional investigation should not consist exclusively or even mainly of synthesis; rather the following five steps should be gone through: discovery of the facts, and an analysis, interpretation, synthesis, and appraisal of them. As to analysis, a valuable guide is provided by Professor Douglas Johnson's paper "The Rôle of Analysis in Scientific Investigation" (*Bull. Geol. Soc. of America*, Vol. 44, pp. 461–494, 1933). The factual items to be considered were given, as to their chief headings, as follows: areal occupance and use features (agriculture, fishing-hunting-collecting, forest exploitation, mining, manufacturing), transportation, trade and communication, habitation, population features, natural environmental features, relations and connections with other regions, unit occupance, and use regions and their subdivisions. For suggestions as to the elaboration of this list Professor Jones referred to his and Professor Sauer's "Outline for Field Work in Geography" (*Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 520–525) and Passarge's "Beschreibende Landschaftskunde" (2nd. edit., Hamburg, 1929).

WRITTEN STRUCTURES FOR PRESENTING THE GEOGRAPHY OF A REGION

Professor Finch stated at the outset that the written structures should be so articulated as to insure interregional comparability. He recognized four types of structure, which, taken together, provide adequate treatment for all kinds of regions. These cover both the physical and the cultural aspects and, like man himself, run the gamut from primitive to aesthetic (some urban regions in this scale being the equivalent of the human aesthete). The first structure deals with regions still in their primeval state, practically unaffected by man, i.e. uninhabited or sparsely inhabited areas. A model treatment of regions of this type is Mecking's "The Polar Regions: A Regional Geography" (*Amer. Geogr. Soc. Special Publ. No. 8*, 1928, pp. 93–338). The second structure has to do with landscapes dominated by forms of human culture. In the treatment of this type it is a question whether to begin with the pristine or the present landscape. Professor Finch favors beginning with the present and working backwards, as it were. The third structure envisages pioneer regions. In these man and nature are associated, but without cultural antecedents as regards man's occupance of the area. As to treatment, possibly an interweaving of natural and cultural elements is best. The fourth structure deals with regions in which the natural and cultural elements are abundantly associated and in which the problem is complicated by the presence of cultural relict forms. The method of treatment that was advocated by the speaker is, in such cases, to begin with the present landscape.

Physical Geography

Felicitously reflecting the specialty of the President of the Association, one half-day session and a number of other papers were devoted to physiography. Professor Douglas Johnson, who was to have been chairman of this session, unfortunately could not be present. Mr. Matthes' presidential address, "Our Greatest Mountain Range, the Sierra Nevada of California," gave a survey of the physiographic history of these mountains according to the latest conclusions, which was prefaced by a genial consideration of their aesthetic aspect. W. S. Cooper dealt with "Types of Pacific Coast Dunes" as developed under the varying climatic and vegetational régimes obtaining within the portion of that belt within the United States. J. C. Rich spoke on certain "Soil Mottlings and Natural Mounds in Northeast Texas As Seen from the Air." W. E. Powers and C. H. Behre, Jr. (introduced) discussed the physiographic history of the upper Arkansas River valley, Colorado, and F. J. Wright (introduced) the post-Harrisburg drainage changes in the upper Roanoke and James River basins in Virginia. Kirk Bryan pointed out the valuable results attained in reducing river silting in the upper Gila, Rio Grande, Puerco, and Pecos valleys by the planting of tamarisk. "The Topographic Aspects of Mineral Technology" were described by W. H. Haas and C. H. Behre, Jr. Under the title of "American Submarine Canyons" F. P. Shepard (introduced) discussed the gorges in the continental shelf, off both the Atlantic and the Pacific coasts, recently revealed for the first time or in greater detail than before through sonic soundings (see also his paper in *Geogr. Rev.*, Vol. 23, 1933, pp. 77–89).

Of two climatological papers one dealt with principles, the other with an application. P. E. Church (introduced), under the title "Dynamic Climatology," discussed the fundamental new study of air-mass movements as the dominant factors underlying climate, the fruitful application of which study to North America by Professor H. C. Willett of Massachusetts Institute of Technology he has just reviewed in these pages (*Geogr. Rev.*, Vol. 24, 1934, pp. 154–156). C. E. Koeppe (introduced) spoke on the relation of meteorological conditions to wheat yield in a region on the southwestern edge of the winter-wheat area in south-central Kansas.

Land Utilization

A number of papers were of special interest in connection with the present national movement for land-use planning. C. F. Marbut, under the title "Land Classification and the Soil Survey," first differentiated between classification of land according to its actual present use and according to its potential future use, in both of which senses the term "land classification" is currently employed. In this paper he used it in a third sense, the classification of land (i.e. essentially of its fundamental element, soils) according to its natural characteristics in terms of agricultural productivity. In this sense a rating is being undertaken of the productivity of half the areas in the United States of which soil surveys have been made, or about one-quarter of the principal agricultural area of the country. This work is being carried out, with the assistance of the Bureau of Chemistry and Soils, by Dr. C. F. Barnes of the Bureau of Agricultural Economics, whose map of the natural land-use areas of the United States, reviewed elsewhere in this number, presents a background for the work in productivity rating. Dr. L. Dudley Stamp, of the University of London, invited guest of the Association, spoke on the Land Utilization Survey of Britain of which he is director, an account of which will appear in a forthcoming number of the *Geographical Review*. One aspect of the work of the Land Economic Survey of Michigan was dealt with by E. C. Prophet (introduced) in "The Recreational Industry of Michigan: A Series of Type Studies."

Three papers discussed problems connected with the area under the jurisdiction of the Tennessee Valley Authority. A. E. Parkins, under the title "Navigation

Improvements on the Tennessee," taking the position that river transportation is outmoded, contended that economic waste is involved in further deepening the navigable channel of the Tennessee River. In support he calculated that, on the basis of the 61 towboats and 183 barges in operation at last accounts, in recent years it has annually cost $2,400,000 to move commodities worth $2,600,000 (see also his "The Tennessee Valley Project—Facts and Fancies," *Journ. Tennessee Acad. of Sci.*, Vol. 8, 1933, pp. 345–357). As an alternative solution he suggested the building of heavy-duty automobile roads for interstate truck traffic and for the use of the motorized army in time of need. Professor Parkins also believes that the project of building a 126-mile-long canal over the Cumberland Plateau between Guntersville on the Tennessee and Birmingport on the Warrior River to provide an outlet to Chicago and the Middle West for the steel and cement produced in the Birmingham district is not justifiable on economic grounds. Floyd F. Cunningham (introduced) in discussing "Muscle Shoals: A Keystone in the National Plan" maintained that in this area dam construction for the production of power is economically valid while dam construction as an aid to river navigation is not. The new need for mobile electrical energy as a result of the planned decentralization of industry and population in the Tennessee River basin will be met in large measure by the impounding of the waters of the Tennessee River by the Wilson Dam at Muscle Shoals and by Dam No. 3, 15 miles above, on which construction has been begun. C. E. Batschelet (introduced), presenting "A Geographical Analysis of Census Facts for the State of Tennessee," grouped the statistics of population, agriculture, and industry according to the natural divisions into which the state falls.

Regional Papers

Some twenty papers were of a regional nature. Among those relating to North America three dealt with Canada. In "The Problem of the Ecumene: The Case of Canada" Mark Jefferson expounded, with reference to Canada, his concept of the "ecumene," "the utilized land of a country, the part from which the people draw life." R. W. Glendinning (introduced) discussed the distribution of population and the settlement of the Lake St. John lowland in Quebec (see this *Review*, pp. 232–237). S. P. Poole (introduced), described some geographical aspects of the Gaspé Peninsula. E. J. Foscue (introduced) spoke on "Geographic Factors in the Development and Decline of Skagway, Alaska," and W. W. Atwood, Jr. (introduced) on the "Glaciation and Land Utilization of the Park Range in Colorado," Ralph H. Brown presented a study of the Sun River irrigation area west of Great Falls, Montana, and its modes of land utilization. O. E. Guthe (introduced), under the title of "Occupance Patterns in the Black Hills," discussed the landscape features resulting respectively from mining, lumbering, and recreational use. What trained geographical observation and reporting can accomplish in providing a balanced picture of the regional individuality of a small area was admirably illustrated by V. C. Finch's paper "Reconnaissance Notes on the Geography of the Mississippi Delta Fringe," based mainly on two days' field work.

Among papers dealing with Latin America R. S. Platt's "Terrene Occupance in the Maracaibo Basin" included an illuminating geographical analysis of the mixed cultural and industrial pattern developed in the amphibious belt along the eastern shore of Lake Maracaibo through the working of the various international oil concessions there. R. H. Whitbeck discussed the geographical and economic reasons for "Unhappy Puerto Rico," and E. B. Shaw (introduced), under the title "The Population of the Virgin Islands of the United States," explained why similar conditions obtain in that group. W. W. Atwood spoke on "The Physical Setting of the Ancient Mayan Civilization in the Highlands of Guatemala." In his paper "Galeana: A Mexican Highland Village" S. N. Dicken (introduced) presented an excellent

study of a type area in the foothills of the Sierra Madre Oriental at an elevation of 1500 feet sixty miles south of Monterrey.

Asia was represented by three papers on Japan. G. T. Trewartha discussed the morphology and distribution of Japanese cities in the main urban belt, which, interrupting the predominantly rural pattern of the country, extends from Yokohama to Kiushiu, and divided the cities into temple or shrine cities, cities at relay points along post routes, and free ports and markets. R. B. Hall in his treatment of "Some Urban Forms in Japan" dwelt especially on the castle towns. D. H. Davis' "Some Aspects of the Occupation of Hokkaido" made patent again the northern character of this island, with its landscape reminiscent of that of our northeastern states.

An illuminating study of the economic geography of the Upper Silesian industrial district, as a result of the author's visit to the area, which also yielded the parallel study on its geographic and political boundaries (*Annals Assn. of Amer. Geogrs.*, Vol. 23, 1933, pp. 195–228) was provided by Richard Hartshorne. H. M. Kendall (introduced) dealt with "The Population Pattern of the Pays du Gers, France," a district in Gascony. "Zagazig," in the Nile delta, the chief center of the Egyptian cotton trade, was discussed by Ella M. Wilson (introduced).

Regional examples were drawn upon to establish general principles in two papers that dealt with political geography. Stephen S. Visher discussed "International Boundaries: A Classification and Evaluation" and Derwent Whittlesey, "Some Landscape Expressions of Effective Central Authority," among which were included the influence of security on the location of towns and the tendency of central authority to bring about uniformity.

Cartography

Four papers dealt with cartography or cartographical methods. Guy-Harold Smith presented a map showing the relative relief of Ohio, embodying, possibly, the first application to an American area of a method of showing degree of brokenness of topography that has been fruitfully used by European geographers (see *Geogr. Rev.*, Vol. 23, 1933, pp. 125–126). F. A. Stilgenbauer (introduced) displayed a new dot population map of Central America constructed on the same principle as his similar map of the United States (*ibid.*, pp. 133–134). Wellington D. Jones discussed the preliminary steps used in constructing a large-scale isopleth population-density map of metropolitan Chicago that he has under way. A discovery of the first magnitude, if the map in question is authentic, as there is reason to believe that it is, was reported by Lawrence Martin. The map, which was found in Italy, was, according to the legend on it, drawn by a daughter of Marco Polo on the basis of a letter written to her by her father. It represents Asia not in the conventional manner of the period but as if drawn freshly from new information and contains such an authentic item as the Great Wall. Further details about the discovery are awaited with interest.

AMERICAN GEOGRAPHICAL SOCIETY

The December Meeting. The regular monthly meeting of the American Geographical Society was held on December 19, 1933, at the Engineering Societies' Building, 29 West 39th Street, President Finley in the chair. Captain Robert A. Bartlett delivered a lecture on "To the Straits of the *Fury* and *Hecla*." He told the story of his latest expedition to the Arctic—the Norcross-Bartlett Expedition, which sailed from New York last June in the *Morrissey*. One of the chief objectives of the expedition was the exploration of the straits where the famous English expedition in the *Fury* and *Hecla* was halted by ice in a search for the Northwest Passage more than a hundred years ago. The lecture was excellently illustrated by motion pictures.

The January Meeting. The Annual Meeting of the Society was held on January 26, 1934, at the Engineering Societies' Building, 29 West 39th Street, President Finley presiding. The Annual Report of the Council (printed below) was read by Vice-President Henry. Dr. Finley then submitted the report of the Special Committee to nominate officers for 1934, announcing his retirement as President and the nomination of Mr. Redmond as his successor. After the election of officers the Society was addressed by Dr. Anson Phelps Stokes on "Africa and Its Problems." Dr. Stokes had just returned from a five months' trip from the Cape to Cairo. After providing a general setting in a survey of the continent and its people, Dr. Stokes, with the aid of a series of lantern slides, described some of the more interesting features of his journey.

The February Meeting. The regular monthly meeting of the Society was held on February 20, 1934, at the Engineering Societies' Building, 29 West 39th Street, Dr. Finley presiding in the absence of President Redmond. In opening the meeting Dr. Finley spoke in part as follows:

"I had expected to have the pleasure and the honor of presenting to you tonight the new President of the Society, Mr. Roland L. Redmond, who has long been a member of the Council. But he has been called to Washington on important business, and at the eleventh hour I have taken his place.

"I had intended to remind him tonight of his predecessors in the office of President. First there was George Bancroft, the famous historian and diplomat; then Francis L. Hawks, the brilliant lawyer, historian, and clergyman; Henry Grinnell, the merchant philanthropist, who contributed munificently to polar exploration. These men were all founders of the Society. Then came Charles P. Daly, the great jurist and founder of one of our medals; Seth Low, merchant, civic leader, and president of Columbia University; Robert E. Peary, the discoverer of the North Pole; Archer M. Huntington, the Maecenas of many arts and a staunch supporter of the Society, as we know; and John Greenough, our beloved Honorary President. These in sequence make an imposing range, some of the peaks perhaps higher than others. There is one name to be added—my own—but I think of myself as a valley running along at the foot of the range, a valley that seems to make the mountains even more impressive. And I may quote Scripture in saying that the valley is itself exalted to be in such association.

"Mr. Redmond, our new President, belongs to the new age in which geography, as I have many times recalled, is bringing the human race into what I call planetary consciousness. He has made the work of this Society his first avocation and has given as generously of his time, his means, and his interest as if it were his profession."

A letter from Mr. Redmond in response to Dr. Finley reads in part as follows:

"I cannot tell you how sorry I was not to be able to be present at the meeting, even though I am sure I should have been embarrassed to hear, first, the distinguished

line of Presidents I am to follow in office, and second, the unduly laudatory expressions in regard to myself. I take exception only to the fact that you treated yourself as a valley in that 'Presidential Range' that you so aptly described."

After calling the meeting to order, Dr. Finley introduced the speaker of the evening, Dr. Peter H. Buck, who delivered a lecture on "Polynesian Discoverers of the Pacific." Dr. Buck, who now is Visiting Professor of Anthropology at Yale University, has for a number of years been engaged in ethnological research in Polynesia on behalf of the Bishop Museum of Honolulu. Among special qualifications for this work is his racial heritage, for his mother was a Maori chieftainess. Dr. Buck illustrated his lecture with stirring quotations and chants from native traditions in addition to some interesting lantern slides.

Elections of Fellows. At the December, January, and February meetings of the Society, there were presented with the approval of the Council the names of 168 candidates who were duly elected as Fellows of the Society.

The "Bibliographie Géographique Internationale" for 1932. The forty-second issue of the *Bibliographie Géographique Internationale* is now ready for distribution in the United States by the American Geographical Society. It is published by the Association de Géographes Français with the collaboration of the American Geographical Society, the Comitato Geografico Nazionale Italiano, the Royal Geographical Society (London), the Société Belge d'Études Géographiques, and the Société Royale de Géographie d'Égypte. The material listed is critically selected, and brief critical notes or references to reviews in outstanding geographical periodicals are added to many of the titles. Current publications—books, periodicals, government and state publications, and maps—are included.

ANNUAL REPORT OF THE COUNCIL

January 26, 1934

To the Fellows of the Society:

During the past fifteen years the Society has addressed itself primarily to research with the object of advancing the borders of geography through the work not only of its own staff but also of geographers outside its staff. It has developed seven main lines of attack upon the problem of increasing and disseminating geographical knowledge:

1. The conduct of research projects within its own house and through its own trained staff;
2. Advice to other organizations with respect to the geographical content of their programs or to research projects that are primarily geographical in nature;
3. Participation in studies of a synthetic character that have wide practical application and that represent the Society's opportunity to interest itself in the affairs of the nation and in the problems of society and its duty as a national institution concerned with national welfare;
4. The maintenance of a library and map collection with catalogues and other aids to research designed to reduce to a minimum the work of locating source material supplemented by a specially trained staff giving efficient service to consultants in geography and investigators in other fields having a geographical basis or relationship;
5. The publication through the *Geographical Review* of original papers dealing with the frontiers of geographical knowledge the world over and thus fully representative of geographical science;
6. The publication of works of scholarship suitably illustrated and according to

standards difficult of achievement by a commercial publisher, the Society being interested not in sales possibilities but in the opportunity of bringing out in adequate form books of high merit and influence;

7. The awarding of medals and the elections to honorary membership for scientific achievement in the field of geography in order to give recognition to men of exceptional promise and thus promote higher standards of achievement.

It is from the standpoint of these seven major objectives that the following summaries of work in the various departments of the Society should be viewed. Each paragraph represents an integral part of a closely organized, well developed, and thoroughly considered program that we believe worthy of the opportunities that we have in our present house with its unrivaled collections of books and maps.

The Geographical Review

In pursuance of its aim to advance the frontiers of geographical knowledge, the *Geographical Review* for 1933 opens with an article by W. D. Albright on the "Gardens of the Mackenzie," a lively description of vegetable, fruit, and flower growing in northern Canada, even beyond the Arctic Circle. Later, in "Crop Growth in High Latitudes," the same author, who is superintendent of an agricultural experiment substation in the Peace River Valley, discusses the favoring meteorological conditions. In contrast with the possibilities suggested in Mr. Albright's articles are reports from regions where settlement is showing signs of retreat. Earl Hanson tells of social regression observed by him in the Orinoco and Amazon basins in 1931 and 1932 and A. Grenfell Price of pioneer reactions to a poor tropical environment noted during a journey in 1932 through Central and North Australia, a land of costly experiment. The decline in prosperity of a tropical island is described by Earl B. Shaw in "St. Croix: A Marginal Sugar-Producing Island." Turning to the temperate zone, we have an exposition by Heinrich Niehaus of the regional problems of German agriculture in the present agrarian crisis.

One aspect of land use, or misuse, has reached so serious a stage in the United States that special measures are being taken to control it; we refer to the recent creation in the Department of the Interior of the Soil Erosion Service, headed by H. H. Bennett. Mr. Bennett, in the July number of the *Review*, describes the technique of approach to the problem and some preliminary results that have already been attained. Another new study with important practical bearings is that of snow surveying; its inception and development are the subject of a well illustrated paper by J. E. Church, chairman of the lately appointed Commission on Snow and Ice of the International Geophysical Union.

Five insert maps, four in color, are included in this volume of the *Geographical Review*. Three of them present, respectively, the physiography of Tanganyika Territory, world climates, and world tides. The first owes a part of its interest to the fact that the authors, E. O. Teale and E. Harvey, of the Geological Survey of Tanganyika Territory, found their inspiration in Erwin J. Raisz's paper, "The Physiographic Method of Representing Scenery on Maps," in the April, 1931, number of the *Geographical Review*. In the "Climates of the Earth" C. Warren Thornthwaite works out for the whole earth the classification previously applied to North America in the October, 1931, number of the *Review*—a scheme that has aroused much interest among meteorologists, botanists, soil scientists, and agriculturalists, as well as among geographers. Hubert A. Bauer's map of tides is the first geographical map of the world-wide distribution of types of tides.

A bold departure from convention is the "Experimental Air Navigation Map of the Pittsburgh-Cleveland Area" by O. M. Miller of the Society's Department of Technical Training, presented as the initial result of a program of air-navigation-map research on which the Society has been engaged for a number of years. With drainage

in white, relief in tones of gray, cultural objects dangerous to flying in red, airports and other flying facilities in orange, etc., the aim was to stress the features of greatest significance as seen from the air. This is a map for the flyer; the use of the airplane in mapping is illustrated by the map accompanying Rear Admiral Richard E. Byrd's account of his flight of December 5, 1929, to Marie Byrd Land. The map was constructed by Commander Harold E. Saunders from aerial photographs taken en route by Captain Ashley C. McKinley, several of which are reproduced.

Recent exploration in the Arctic also finds place in this volume of the *Geographical Review*. Knud Rasmussen gave a preliminary report of the Sixth and Seventh Thule Expeditions in southeastern Greenland. It is our profound regret that his untimely death robs us of further hoped-for contributions. Lauge Koch summarizes the work up to date of the Danish Three-Year Expedition to King Christian X Land, an undertaking remarkable for the scale and thoroughness with which it has been organized. The unique feat of the circumnavigation of Franz Josef Land in 1932 is recounted by the leader, N. N. Zubov, of the Oceanographical Institute of the U. S. S. R.

The recent change in the administrative status of Newfoundland gives heightened interest to Julian E. Rothery's "The Newest Map of the Oldest British Colony." The map therein described, on the scale of ten miles to one inch, is an outcome of forest engineering work. In striking contrast, the same number of the *Review* contains the account of the finding of a "Lost Map of Columbus" and its description by Paul Kahle, the well known German Orientalist. A suggestive contribution by Margaret Irene Fead presents notes on the development of the cartographic representation of cities from the earliest times to the present day. Well worked-out examples of the functional mapping of cities appear in Preston E. James's article on Rio de Janeiro and São Paulo.

Among regional studies is a rather unusual contribution, "The Black Man's Industries" by Robert H. Forbes, dealing with various primitive arts and crafts of the French Sudan. An outcome of Dr. Forbes's discussion of the iron industry is Harold Peake's sketch of "The Origin and Early Spread of Ironworking." Recent advances in our knowledge of submarine configuration are reflected in Francis P. Shepard's "Submarine Valleys"; Sidney A. Reeve's "Ship Evolution and Social Evolution" presents a provocative argument; recent exploration in South America is represented in Desmond Holdridge's article on his work in northern Brazil between the Rio Branco and the Serra Parima in 1932. W. L. G. Joerg's account of the development of Polish cartography since the World War is of timely interest in view of the meeting of the International Geographical Congress in Warsaw in 1934.

Special Publication

The editorial work was completed during the year on a volume entitled "The Discovery of the Amazon" (published early in January, 1934). This book is mainly a translation of a work by the eminent Chilean scholar, José Toribio Medina, and contains, in addition to the original account of Orellana's voyage of discovery in 1541 and 1542 by Friar Gaspar de Carvajal, a member of the expedition, and other contemporary documents, most of which had never been published before, an authoritative and critical discussion of Orellana's original expedition. It treats also of Gonzalo Pizarro's expedition in 1541 from Quito to the cinnamon country in the eastern foothills of the Andes (of which Orellana's voyage was an outgrowth) and of Orellana's second expedition to the Amazon in 1545 and 1546.

The translation was made by Mr. Bertram T. Lee, an American engineer long resident in Peru and a collector of original documents on the early history of that country, and Professor H. C. Heaton, of the Department of Romance Languages of New York University. Professor Heaton, who edited the volume, has also added

to Dr. Medina's work a translation of a second version of Carvajal's account from Oviedo's sixteenth-century "Historia General y Natural de las Indias." The volume published by the Society thus provides an exhaustive treatment of the story of the discovery of the Amazon and, since Dr. Medina's work was published in an edition of only 200 copies, makes easily available for the first time the most important of the original documents on the subject.

Department of Hispanic American Research

Two new sheets of the Millionth Map of Hispanic America were published in 1933, bringing the total number of published sheets of this 100-sheet map to 44. Twenty-four additional sheets are drawn and ready for lithographing and printing, making a total of 68 sheets on which the work of the Society is completed. Compilation work during the year was devoted chiefly to the Central American, Brazilian, and Argentine sheets of the map.

The "Catalogue of Maps of Hispanic America" on which the Society has been engaged for a number of years was completed during the year and published in four volumes. This catalogue covers the maps in periodicals and books and sheet and atlas maps at the American Geographical Society, the New York Public Library, the Library of Congress, the Pan American Union, and the libraries of Columbia, Yale, and Harvard universities and represents five years of work on the part of an expert map cataloguer and eighteen months of editorial work.

Department of Technical Training

Instruction in field astronomy and in various methods of aerial and ground surveying was given during the year to eight persons. About 60 others consulted the staff of the department for information and advice, and surveying instruments were lent to ten field parties.

A number of expeditions availed themselves of the assistance afforded by the department in planning mapping programs and in working up the results of survey work. Among these special mention may be made of the Lincoln Ellsworth Transantarctic Expedition, the Louise A. Boyd Expedition to East Greenland, the Norcross-Bartlett Expedition, and the Sikong Expedition of 1932. The map of Minya Konka and surrounding country by Mr. Richard L. Burdsall of the last-named expedition was published in the January, 1934, number of the *Geographical Review*.

For the Lincoln Ellsworth Transantarctic Expedition new aids to air navigation in the Antarctic were worked out, including maps, charts, and tables, and a novel type of plotting board, designed and constructed at the Society, by the use of which the process of plotting position lines on the chart is reduced to four mechanical motions and the necessity of making computations completely eliminated. Three of these plotting boards were constructed for Mr. Ellsworth, two of which he has with him and one of which he presented to Admiral Byrd.

In order to carry out photogrammetrical surveys of glacial-marginal features the head of the department acted during the past summer as chief surveyor with the Louise A. Boyd Expedition to East Greenland.

Good progress has been made on the topographical map of a large section of northern Labrador that is being constructed from oblique aerial photographs taken by the Grenfell-Forbes Expedition of 1931. The purpose of this survey, which was planned by and carried out under the direction of the Society, was not only to map a large area hitherto unsurveyed but also to carry out an experiment in a new technique developed at the Society for constructing topographical maps from oblique photographs. Consequently, since the routine of procedure must be worked out and the practical difficulties overcome as they are met, without the benefit of previous experience, the preliminaries to the actual plotting of the map have taken considerable time. The

United States Hydrographic Office has taken a special interest in the work and has detailed a naval officer and an expert cartographical engineer to learn the method and assist in working up the material and plotting the map.

In connection with this method of aerial mapping a special type of photogoniometer (the only one of its kind) for the rapid measuring of horizontal and vertical angles from oblique photographs has been designed by the department with the assistance of Mr. David W. Mann of the Mann Instrument Company of Cambridge, Mass., and is giving excellent results.

Library

During the year 380 books, 488 pamphlets, 1009 volumes of periodicals, 1976 maps, and 27 atlases were added to the Society's collection. The collection now consists of 98,914 books and volumes of periodicals, 16,653 pamphlets, 87,132 maps, 1689 atlases, and 8619 photographs.

Among the gifts to the library and map collections in 1933 are: Mathew Dripp's "Plan of New York City," 1867, and G. W. and W. S. Bromley's "Atlas of New York City, Manhattan Island," 1891, from Mr. Reginald Pelham Bolton; J. H. Young's "New Jersey," 1834, and W. Hooker's "Plan of the City of New York," 1832, from Mr. Harrison Hale Schaff; "Monumenta Cartographica Africae et Aegypti," from Prince Youssouf Kamal; the fourth edition of "Atlante Internazionale," from the publishers, the Touring Club Italiano; 68 maps of the election districts of New York City for the year 1933, from the Board of Elections; Jose's "Australia" and Philippson's "Grundzüge der allgemeinen Geographie," from Major General Crozier; Bell's "The Religion of Tibet," Suggate's "Australia and New Zealand," and Young's "American Minority Peoples," from Mr. Richard Crane; nine Russian pamphlets from Professor J. Schokalsky; a collection of his manuscript maps and drawings of Cerro Duida and Esmeralda, Venezuela, from Mr. Charles B. Hitchcock.

Miss Louise A. Boyd has donated to the Society's photographic collection five reels of motion-picture film taken on her expedition to East Greenland in 1931. Other gifts to the photographic collection include photographs of Mount Washington Observatory from Mr. R. G. Stone and photographs of Enderby Land from Mr. Lars Christensen. This collection was begun in 1931 as a special feature of the Society's aids to geographical research and now consists of nearly 9000 classified and catalogued items. The Society would welcome additional gifts of representative photographs.

Cards representing over 7500 titles of books, periodical articles, and maps were added to the research catalogue. This catalogue, which was initiated in 1923 as an aid to research workers in using the Society's collections of source materials, now contains about 62,500 entries. More than 650 persons consulted material in the library and map collections during the year.

The library continued its coöperation in the preparation of titles and abstracts for the *Bibliographie Géographique Internationale.*

Pioneer Settlement Studies

It was announced in the Annual Report for 1932 that the fieldwork on the study of pioneer settlement in Canada had been completed and that the results were to be published in a series of nine volumes by the Canadian Pioneer Problems Committee. This is the first major study of a pioneer region carried out as a part of the program of studies of pioneer settlement undertaken by the Society some years ago with the coöperation and support of the Social Science Research Council.

Of the nine volumes that will bear the series title of "Canadian Pioneer Settlement" the first, a 250-page volume by Dr. W. A. Mackintosh entitled "Prairie

Settlement: The Geographical Setting," is about to be published. It deals with the settlement of the three prairie provinces of Manitoba, Saskatchewan, and Alberta and more especially with the effects that climate, soils, and the development of railroads have had on the spread of population in that area as a whole. The volume also takes up in greater detail settlement and agricultural conditions in the five main subregions of the area—the Red River Valley, the Park Belt, the Prairie Plains, the Forest Areas, and the Peace River Country.

A second volume, consisting of a detailed sociological study of the Peace River Country by Dr. C. A. Dawson of McGill University, is in press. Of the remaining seven volumes, six will deal with other aspects of the colonization of the Prairie Provinces—history of settlement, land and administration policies, company colonization, agricultural progress, economic and sociological problems, and ethnic groups—and one with settlement on the forest and mining frontiers of British Columbia and eastern Canada.

The two articles by W. D. Albright in the *Geographical Review* for 1933 illuminate the important problem of the northern limit of agriculture in Canada and amplify the discussion of that theme in Dr. Mackintosh's volume, where it is based mainly on Mr. Albright's work. Other articles in the *Review* for 1933 that reflect the Society's interest in pioneer settlement are A. Grenfell Price's report on pioneer conditions in Central and North Australia and Earl Hanson's paper on social regression in the Orinoco and Amazon basins.

Expeditions

In addition to active association of the Society with four expeditions during the past year, the leaders of a number of important expeditions have availed themselves of the opportunity of publishing the geographical and cartographical results of their work in the *Geographical Review*.

The Society participated in the support of the Yale North India Expedition under the leadership of Dr. Hellmut de Terra, which completed its survey work and geological and physiographic studies early in the year. Dr. de Terra discussed the work accomplished by his expedition in a lecture before the April meeting of the Society, and his report on the physiographic results was published in the January, 1934, number of the *Geographical Review*, accompanied by a topographical map on the scale of eight miles to the inch reduced from a survey made by the expedition on the scale of two miles to the inch of an area of some 4000 square miles in the eastern Karakoram and northwest Himalaya.

The Society assisted in formulating the plans for the Louise A. Boyd Expedition to East Greenland carried out during the past summer, and a member of the staff acted as chief surveyor of the expedition. Maps and other aids to air navigation were furnished to the Lincoln Ellsworth Transantarctic Expedition. Surveying instruments were lent to the Norcross-Bartlett Expedition, and a member of the party received training at the Society in surveying and field astronomy. A member of the Sikong Expedition of 1932, which made the first ascent of Minya Konka, spent several months at the Society working up his surveys and barometrical and astronomical observations with the assistance of members of the staff.

During the year there appeared in the *Geographical Review* articles on Rear Admiral Byrd's flight to Marie Byrd Land in 1929, Desmond Holdridge's explorations in northern Brazil between the Rio Branco and the Serra Parima in 1932, the work of the Sixth and Seventh Thule Expeditions, the circumnavigation of Franz Josef Land under the auspices of the Oceanographical Institute of the U. S. S. R. in 1932, the work accomplished from the summer of 1931 to the summer of 1933 by the Danish Three-Year Expedition to King Christian X Land, and a review of the oceanographic work of the *Meteor*, *Carnegie*, *Dana*, and *Snellius* expeditions.

Representation at Scientific Meetings

A member of the staff of the Society attended the annual meeting of the Association of American Geographers at Evanston, December 26 to 28 and is reporting the meeting in the *Geographical Review*.

The Society was also represented at the annual meetings of the National Research Council, the Social Science Research Council, the National Academy of Sciences, and a number of other organizations in whose work it is participating.

The Director of the Society, by consent of the Council, was authorized to accept the invitation of the National Academy of Sciences and the National Research Council to act as chairman of the National Research Council. Subsequently there was appointed by executive order of President Roosevelt a Science Advisory Board, of which Dr. Bowman became a member and vice-chairman. This board was set up to advise the government on scientific problems.

In the Annual Report for 1932 it was mentioned that a representative of the Society had become a member of the Commission on the Social Sciences in the Schools appointed by the American Historical Association. At the request of the Commission, Dr. Bowman, who acted as the Society's representative, prepared a volume entitled "Geography in Its Relation to the Social Sciences."

Lecture Program

During the past year the speakers and titles on the Society's lecture program were as follows: Mr. Vincenzo Petrullo, "Primitive Tribes of Matto Grosso"; Mr. Herbert C. White, "With the Camera in an Enchanted Empire"; Mr. Earl Hanson, "The Amazon and the Andes Today: A Region of Social Regression"; Dr. Hellmut de Terra, "The Yale North India Expedition"; Air Commodore P. F. M. Fellowes, "The Conquest of Everest"; and Captain Robert A. Bartlett, "To the Straits of the *Fury* and *Hecla*."

Report of the Treasurer for 1933

The Council has received a report from the Treasurer giving a summary of the income and expenses of the Society, and the accounts of the Society have been audited by certified accountants whose report is on file at the office of the Society.

This report naturally reflects the financial conditions that have prevailed throughout our country in recent years. As a large proportion of the funds of the Society has been invested in guaranteed mortgages, the Society has had the same experience as other institutions with such investments.

In order to continue its operations the Society has had to reduce expenses greatly. A drastic cut in salaries had to be made, but, notwithstanding this, the Society, through the loyalty and competency of its staff, has been able to keep up its standards, as will be noted from the report just made. Too much credit cannot be given the staff for the spirit in which they have met this difficult situation.

Change in Presidency

All of those interested in the Society will regret the retirement of Dr. Finley from the Presidency, which he has so ably filled for the past eight years. Fortunately he will remain on the Council, so the Society will still have the benefit of his association. During his tenure of office the monthly meetings have been no less an opportunity to hear Dr. Finley's original and graceful presentations of the speakers than to hear the speakers themselves. In many ways he has warmly supported the administration of the Society's affairs and helped to increase its reputation and prestige, besides giving generously of his time and strength. His "fliers' globe," with the routes of practically all the great flights drawn by the fliers themselves and autographed, will always be one of the Society's more cherished possessions.

The Society has been fortunate in recent years in electing to its Council a group of younger men, and it is from this group that the new president, Roland L. Redmond, Esq., has been chosen. Mr. Redmond is a member of one of our most prominent legal firms and has shown a lively interest in the Society ever since he became a member of the Council in 1922. Last year he was elected a Vice-President. The Fellows are to be congratulated in having a President so well qualified to maintain and enhance the traditions and reputation of the Society in the fields of scholarship and education.

PHILIP W. HENRY, *Chairman*

REPORT OF THE SPECIAL COMMITTEE

New York, January 18, 1934

The committee appointed at the meeting of the Council held on December 14, 1933, to nominate officers for the vacancies to occur in the Council in January, 1934, beg to nominate the following named gentlemen for the offices designated and move that the same be approved and presented to the Society for election at its meeting to be held on January 26, 1934.

		Terms to expire in
President	Roland L. Redmond	January, 1935
Vice-President	W. Redmond Cross	January, 1937
Recording Secretary	Hamilton Fish Kean	January, 1937
Treasurer	Henry Parish	January, 1935
Councilors	Philip A. Carroll	
	Charles R. Crane	
	William Hale Harkness	January, 1937
	Archer M. Huntington	
	Wesley C. Mitchell	
	John H. Finley	January, 1935

John Greenough
Oliver B. James } *Committee*
John H. Finley

GEOGRAPHICAL RECORD

NORTH AMERICA

The Rectification of the Rio Grande in the El Paso-Juarez Valley. On November 10, 1933, ratifications of the convention between the United States and Mexico for the rectification of the Rio Grande in the El Paso-Juarez valley were exchanged by the two governments, and on November 13 the convention was proclaimed by President Roosevelt.

Elimination of the present flood menace in the valley and stabilization of the international boundary were the chief motivating factors prompting both governments to request the International Boundary Commission to formulate plans for the rectification of the portion of the Rio Grande channel between El Paso and Box Canyon.

The absence of scouring floods through the El Paso-Juarez valley since the completion of the Elephant Butte Dam in 1916 has resulted in the aggradation of the Rio Grande. The silting up of the channel, aggravated, too, by the use of the water for irrigation, has reached a point where small floods due to rainfall discharge from the arroyos between Elephant Butte Dam and El Paso are of annual occurrence, menacing the improved properties in the cities of El Paso and Juarez and in the valley lands below. Furthermore, the meandering stream is subject to channel changes, which have given rise to legal and economic difficulties made more than usually confusing because an international boundary was involved.

The rectification plan provides for a straightening of the river from El Paso to Box Canyon below Fort Quitman whereby the channel will be shortened from 155 miles to 88 miles and the gradient increased from 1.82 feet a mile to 3.20 feet a mile, which, it is believed, will provide a minimum velocity during normal flow capable of carrying the usual sand and silt borne by the Rio Grande. Levees will be constructed to confine the river to the new, artificial channel. The accompanying map shows the proposed changes to be made immediately below El Paso.

Since floods at El Paso-Juarez are now chiefly formed from the run-off of the area between Elephant Butte Dam and El Paso-Juarez, it is proposed further to control the possibility of floods by the construction of a detention dam at Caballo, 22 miles below the Elephant Butte Dam. The Caballo Reservoir, by controlling half of the direct drainage area and by acting as a temporary check on the spills from Elephant Butte Dam, will reduce by almost one-half the probable flood peak at El Paso-Juarez. Furthermore, the width of the rectified channel, the strength of the levees, the length of bridges, and the expense of future maintenance may all be decreased if the Caballo Dam is built, as these economies will more than offset the cost of the dam.

The straightening of the meanders of the channel will necessarily result in the exchange between the United States and Mexico of small areas of land detached by the process. The areas involved have been surveyed and computed by the International Boundary Commission so that the total acreage detached from each country will be the same. Three thousand four hundred and sixty acres will be segregated from the United States and a like amount from Mexico.

Taking into consideration the investments of each country in the El Paso-Juarez valley and the benefits to be received by the rectification of the Rio Grande's channel, the commissioners have prorated the cost of the straightened channel at 12 per cent for Mexico and 88 per cent for the United States.

A federally owned and controlled river channel will prevent private encroachments on the area required for flood protection and will be of assistance in the enforcement of national immigration and customs laws of both countries. Thus, in addition to solving the flood problem in the valley, the rectified channel will become a much more satisfactory international boundary than the present meandering, changing

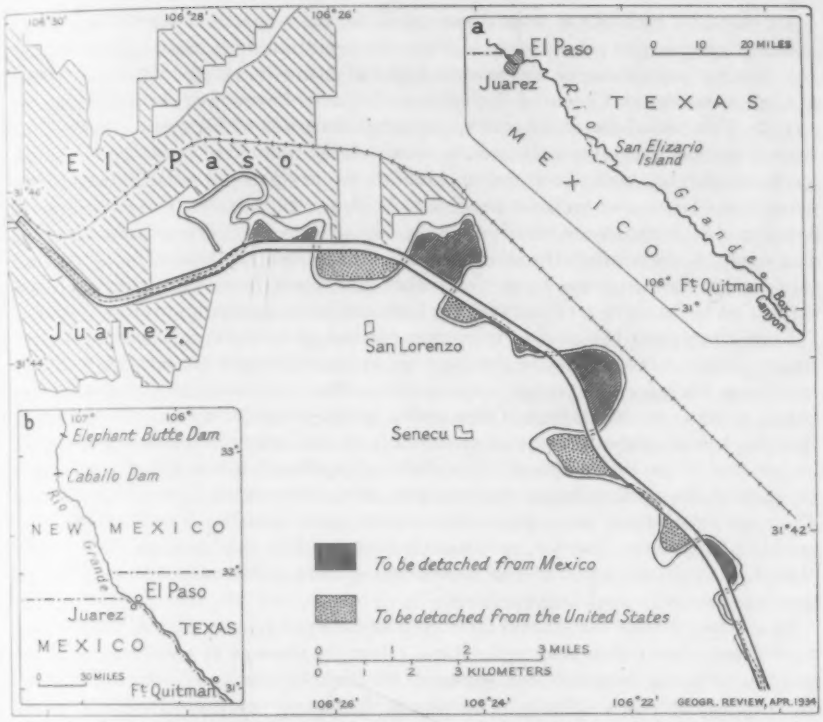

FIG. 1—Map showing the proposed straightened channel of the Rio Grande for a sample section just below El Paso. The inset in the upper right-hand corner (a) shows the entire length of the channel to be rectified. The inset in the lower left-hand corner (b) shows the general area included in the project.

stream has ever been. With the channel defined by levees on both sides, the position of the boundary will become practically permanent, making it as ideal a boundary as a river boundary ever can be.

The detailed report of the International Boundary Commission, together with memorandums and notes exchanged between the United States and Mexico concerning the rectification plans, appears in the "Message from the President . . . " (*72d Congr., 2d Sess., Senate, Executive E.*, 1933).

EDITH M. FITTON

Natural Land-Use Areas and Types of Farming in the United States. The "Natural Land-Use" map and the "Types of Farming" study recently published by the Bureau of Agricultural Economics and the Bureau of the Census, respectively, shed an instructive light on the troublesome problem of formulating sound general land-utilization policies in the United States. Taking into account comparatively local environmental differences in climate, topography, soil, geological formations, natural vegetation, and drainage, C. P. Barnes and F. J. Marschner recognize 272 natural land-use areas in the United States (Natural Land-Use Areas of the United States, 1 : 4,000,000, 1933). Their character may be gauged by the nomenclature employed in their designation; for example, Colorado River Desert, Central Nebraska Loess Hills, Osage Prairies, Gulf Coast Marshlands, Southern Illinois Gray Lands. Because factors other than the environmental play significant rôles in the use of areas, F. F. Elliott, using 1930 census data, delineates no less than 514 actual major type-of-farming areas! Defining the type of farm in terms of the proportion of the gross income

contributed by each of the several sources of income reported in the General Farm Schedule of the 1930 census of agriculture, he determined his areas on the basis of the relative importance of the several types of farms included (Fifteenth Census of the United States, Census of Agriculture: Types of Farming in the United States, 1933). This technique, incidentally, enhances the value of his areas considerably, since it not only delimits each area in terms of the individual farm type—a much more satisfactory unit than the unclassified county-group totals generally used heretofore—but it also makes it possible to bring out the simplicity or complexity of areas in that it shows the relative importance of types of farming other than the dominant. Unfortunately the accompanying map (scale approximately 1 : 5,750,000) showing distribution of the areas is on rather thin paper; however, a clearer, colored version on the scale of 1 : 8,000,000 has been published separately.

Employing 40 as the general minimum percentage of the total income that any source should represent before the farm was classified under a special type, Elliott recognizes 12 principal groups: cash grain, cotton, crop specialty (tobacco, soy beans, mushrooms, etc.), fruit, truck, dairy, poultry, animal specialty, stock ranch (grazing basis), general (value of products from one source representing less than 40 per cent of the total value of all products of the farm), self-sufficing (50 per cent or more of the total value of the products of the farm used by the family), and abnormal (institution or country estate; part time; boarding and lodging; forest product; horse farm, feed lot, or livestock dealer). The kaleidoscopic shift in type of farm and relative importance of type from region to region account mainly for the large number of type-of-farming areas.

Of all these groups the general-farm type looms as of greatest significance in these days of restricted commercial agriculture. Here the pressure of economic conditions and the environmental complex appear to be most flexible and least exacting, permitting the operator to distribute his eggs in the greatest number of baskets. Moreover, should restriction continue, necessitating a greater abandonment of the one-crop farm, the general type, which is largely concentrated east of the semiarid plains and north of the cotton type, bids fair to become the outstanding center of rural society in the United States. It is admirably adapted to subsistence farming.

With such diversity in both natural conditions and practice, it becomes readily apparent why the efforts of the administration and other agencies to formulate generally acceptable agricultural policies either for the present emergency or for normal times meet with such a widespread reactional response. Even such a standard homogeneous region as the Corn Belt, following O. E. Baker's boundaries, consists of no less than some 20 *natural* land-use areas and more than 40 *real* type-of-farming areas! No wonder a blanket recommendation urging—say—a 10 per cent horizontal cut in corn acreage stirs up a hornet's nest. Such a proposal overlooks not only the variation in corn acreage handled by different operators but also the crops with which corn is grown in combination and the possibilities of substitutes. The farmer with 50 per cent of his land in corn will naturally view the exhortation to cut 10 per cent quite differently from one whose acreage is less than 10 per cent.

LOUIS A. WOLFANGER

Population Changes in Three Massachusetts Counties. In a recently published doctoral thesis L. E. Klimm seeks to discover "The Relation Between Certain Population Changes and the Physical Environment in Hampden, Hampshire, and Franklin Counties, Massachusetts, 1790–1925" (University of Pennsylvania, Philadelphia, 1933). The counties in question are traversed by the Connecticut Valley Lowland and include parts of the adjacent uplands. An ingenious method of analysis was employed. For the total population of each "town" (i.e. township) a curve was plotted of index numbers, 1790–1925, thus permitting ready comparison of

trends. The curves were then classified on the basis of their forms. Four distinct types were apparent, representing, respectively, a steady and rapid growth; a rise, decline, and rejuvenation; a rather consistent decline since the first part of the nineteenth century; and erratic fluctuations. The distribution of these types (except the last) was seen to bear a definite relation to topography and soils. Continuous increase—associated with the development of manufactures and commerce—has been recorded only on the floor of the Lowland and in tributary valleys in the vicinity of Springfield and Greenfield, where east-west lines of communication cut across the north-south grain of the region's relief. The towns that have experienced rejuvenation comprise the rich farm lands of the central part of the Lowland where specialized farming (tobacco and onions) has been developed during recent decades. Continuous decreases have occurred on the uplands.

Dr. Klimm also discusses changes in the occupations and origins of the population. "There has been a considerable increase in the number and proportion of immigrants in the agricultural towns. . . . The races making up what is known as the 'new' immigration . . . have, contrary to the common belief, distributed themselves rather widely throughout the region and are especially more apt to be found in the agricultural towns than are the people of the 'old' immigration."

It may be added that the population of the Connecticut Valley Lowland increased more rapidly between 1910 and 1930 than that of any other part of New England. The average increase throughout New England was 24.6 per cent, whereas that of the part of the Lowland lying in Massachusetts was 50.3 per cent and that of the entire Lowland 50.9 per cent (New England's Prospect: 1933, *Amer. Geogr. Soc. Special Publ. No. 16*, 1933, p. 17).

The Saguenay Trench and the Lake St. John Basin. "Ce sont dans la Province de Québec des cas véritablement exceptionnels." Thus does Raoul Blanchard call attention to the unusual character of these great depressions located in the milieu of the Laurentian Shield (Études canadiennes: IV, Le Saguenay et le Lac Saint-Jean, *Rev. de Geogr. Alpine*, Vol. 21, 1933, pp. 5–174).

The waters of the Champlain Sea, lapping the edge of the retreating glacial ice, invaded the deep trough of the Saguenay and reached westward to include the depression that is now partially occupied by Lake St. John. During this submergence marine clays, often capped by sands, were deposited within the limiting borders of the glaciated uplands. The course of the subsequent emergence is marked, step by step, in the terraces that encircle Lake St. John and those that flank the deep waters of the Saguenay. The pre-Champlain history of these depressions is very involved and perhaps, as yet, incompletely described. However, it is certain that they represent one of the few areas in the pre-Cambrian upland where younger rocks are preserved; moreover, they present, in the form of the unconsolidated terrace materials, one of the largest portions of arable land within the upland's confines, this latter being especially true of the basin of Lake St. John. Both the trench and the basin are oriented with major fault lineaments—one to the north, which parallels the Saguenay and follows the Ste. Marguerite Valley, and the other to the south, with much the same trend. These diverge as they proceed toward the northwest, and it is in the region of greatest divergence that the Lake St. John basin is found. In addition to tectonic forces, the great glaciers have also had a part in shaping the depressions, namely in aiding the erosion of the basin and in the production of a virtual fiord from Chicoutimi to the Saguenay's mouth.

The settlement of this region was long retarded by the fur-trade monopoly, represented in the "Postes du Roi." By the fourth decade of the nineteenth century, however, this control was broken and parishes were established along the Saguenay, particularly in the "presqu'île de Chicoutimi." This settlement spread westward into the southeastern part of the Lake St. John basin, where Hébertville was per-

manently established by 1851. Since then the spread has been to the west and north until it now encircles the lake.

At present there are some 100,000 persons in the region, concentrated particularly in the southern and southeastern parts of the basin and in the upper portion of the Saguenay Valley. In the former area agriculture is the chief occupation, although industry is represented by pulp and newsprint mills and the great water-power development at the Grande Décharge; in the latter area agriculture and industry vie with each other for the lead. The large aluminum plant at Arvida; the development, for power purposes, of the rivers; the wharves at Bagotville and Port Alfred—all attest the growing industrial importance of the upper Saguenay.

ROBERT M. GLENDINNING

"The Trades in Flood" over Puerto Rico. The difficulty of obtaining upper-air observations over the sea is one of the major obstacles to fact finding with respect to the general circulation of the atmosphere. Highly successful marine aerological programs such as those of the *Meteor* expeditions, the voyages of the *Carnegie*, and a few others, while contributing much, nevertheless emphasize only too clearly the gaps in our knowledge of this field. In view of this and of the present and prospective development of oversea air transport, especially between the Americas, the upper-air data from the San Juan, Puerto Rico, station of the U. S. Weather Bureau are of great importance. The station is strategically located for the study of the Atlantic trade-wind and related circulations. A program of pilot-balloon flights has been carried out there without interruption since 1920. Until 1927, daily flights were made only during the months of June to November—the hurricane months: that year marked the beginning of the present year-round program. Altogether, some 2500 flight records are available for study.

Dr. O. L. Fassig, attacking the problem of determining the variations in depth and strength of the trade winds as related to changes in pressure distributions over the North Atlantic, presents (The Trade-Winds of the Eastern Caribbean, *Trans. Amer. Geophys. Union, Fourteenth Ann. Meeting, April 27, 28, 29, 1933*, Washington, 1933, pp. 69–78) a series of diagrams showing the outstanding local features of the trade-wind circulation. The following are of particular interest. (1) The succession of mean annual resultant wind directions up to some 12 to 14 kilometers: easterly trades up to about 3 kilometers; northeasterly in 3 to 6-kilometer levels; westerly (anti-trade) above these to some 9 kilometers; west-northwesterly at 10 to 12 kilometers; easterly in evidence in the 14 to 16-kilometer levels during part, at least, of the summer, autumn, and winter. (2) Mean velocities for the year up to 12 kilometers, which show two minima—at the surface and at 4 kilometers—and two maxima—near the top of the first kilometer and at about 11 kilometers. One may remark parenthetically that, as far as the San Juan data indicate, the flying level for least wind is on the average very close to the sea surface; the top of the first kilometer is to be avoided except for following winds. (3) Changes in the depth of the trades and their relations to stormy weather. The depth of the trade virtually doubles from a minimum of 4 to 5 kilometers in late spring to a maximum of about 9 kilometers in late summer and early autumn (major hurricane season). This statistical doubling of the depth is really the result of the occurrence of great temporary surges of air from the east above the usual trade wind, whereby in the course of 4 or 5 days the depth of the trade is increased and the westerly (anti-trade) correspondingly displaced, frequently up to the cirrus level and occasionally up to 15 kilometers. Pointing out that "heavy rains and more or less severe atmospheric disturbances are always associated with such conditions," which he calls "the trades in flood," Fassig concludes that the records leave no doubt of a close connection between the occurrence of hurricanes and these rapid increases in the depth of the

trades. He likens these deepenings from the east, beginning at the 4 to 5-kilometer level, and their attendant convectional conflict with the anti-trade to the advances, in higher latitudes, of the polar-front waves from the west at sea level, with their characteristic convectional disturbances along the zones of conflict between polar and tropical air masses.

B. M. VARNEY

The Chachas of St. Thomas. In the January number of the *Geographical Review* A. Grenfell Price described the white community of Saba Island, Dutch West Indies. Another interesting "laboratory" case for the study of northern-white settlement in the tropics is afforded by the Chachas, whose story is told by Earl B. Shaw in the February number of the *Scientific Monthly*. On the island of St. Thomas is a small group of French descent that has kept its racial purity intact and preserved its language, religion, and customs. The name, which is objectionable to the people themselves, was bestowed on them by the English-speaking colored folk, who could not understand the strange tongue. Various origins have been ascribed to the Chachas. Most probably they are descendants of Breton settlers on St. Bartholomew and St. Kitts who left those islands in the middle of the nineteenth century in the hope of improving their economic situation. They have not succeeded any too well in spite of their thrift and industry, for they have chosen an ungrateful environment.

The Chachas number about 900, divided into two groups. The one, a fishing community, lives at Carenage, a suburb of the city of St. Thomas. The submarine banks of the surrounding waters afford favorable conditions for the prosecution of their hereditary industry, but there is only a local market for the product, and the family income must be eked out from other sources; for example, the women weave baskets. The second, a farming community, lives three to five miles north of St. Thomas, on the northern slopes of the island to take advantage of the greater moisture and lesser evaporation on the windward side. The small terraced farms cut out of the steep, brush-covered slopes are used chiefly for the growing of bananas, tanias (a tropical tuber), sweet potatoes, pigeon peas, yams, and cassava. Marketing is a difficult problem. There is little chance for export, and the products, carried over the mountain trails, must compete in the home market with products from St. John and Tortola.

SOUTH AMERICA

The Origin of the Galápagos Islands. The Darwin Memorial Expedition, celebrating the centennial of the voyage of the *Beagle* and its most illustrious member, plans the erection of a monument on Chatham Island in the Galápagos. The other, "more lasting" monument stands in all discussions of the physical and natural history of the islands certain of whose phenomena were "made classic by the pioneer labors of Darwin." It is a timely moment to note the results of the investigations of the St. George Expedition of 1924–1925 as described by L. J. Chubb (Geology of Galapagos, Cocos, and Easter Islands, *Bernice P. Bishop Museum Bull. 110*, Honolulu, 1933).

Mr. Chubb recognizes three phases in the building of the Galápagos. The first is that of the great volcanoes, which he considers—and he ascended Mt. Williams to a height of 1500 feet—to be mainly of pyroclastic material, at least in the later stages, in which opinion he differs from Wolf, who attributed the abrupt change in aspect of the mountain slopes above the lava plains to weathering. The second phase of minor eruptions produced the enormous number of parasitic cones. Here also Chubb disagrees with Wolf's view that two fundamentally different modes of action were involved. The third phase, still in progress in the western, or younger, of the islands (James, Albemarle, Narborough), is represented by the emission of lava from fissures in the flanks of the major volcanoes. An uplift of a few hundred feet

probably occurred between phases two and three, but since then the islands have been stationary, with slight local subsidence.

Mr. Chubb points to the structural resemblance between the Galápagos and the Marquesas. The latter, however, appear to be the older. While the groups cover about the same area, the land surface of the Marquesas, reduced by faulting, subsidence, and erosion, is only about one-sixth that of the Galápagos. The two archipelagoes lie at opposite ends of the submarine Albatross Plateau (depths less than 2000 fathoms) on sets of intersecting fissures. The history of Easter Island, on the southern margin of the plateau, seems to be similar to that of the Galápagos, but it is considerably older. No trace of continental rock was found on the island and no evidence of subsidence: "the theory that the island is a relic of a much larger land mass that has subsided within the human period must be abandoned."

In commenting on the absence of coral reefs about the Galápagos Mr. Chubb vindicates the view of Dana that this was due to low water temperatures (see also W. M. Davis: The Coral Reef Problem, *Amer. Geogr. Soc. Special Publ. No. 9*, New York, 1928, p. 149). The visit of Agassiz, who discredited the suggestion, was coincident with the great 1891 activity of the warm current, El Niño, which periodically displaces the Humboldt Current. Mr. Chubb earlier expressed the opinion that periodic chilling of the surface waters around the Marquesas, where coral development is poor, might be attributed to extensions of the cold Humboldt Current (Geology of the Marquesas Islands, *Bernice P. Bishop Museum Bull. 68*, Honolulu, 1930).

The Cold Pole of South America. We hear much of the cold pole of Siberia (see, for instance, S. T. A. Mirrlees: Reduction of Temperature to Sea Level; the "Cold Pole," *Meteorol. Mag.*, Vol. 68, 1934, pp. 280–283); a discussion of the cold pole of South America is something of a novelty. Julio Bustos Navarrete, director of the Observatorio del Salto in Chile, places this cold pole in the Andes of northern Patagonia in an area defined by the meteorological stations of Chos Malal, Las Lajas, Bariloche, and Lonquimay (*Monthly Weather Rev.*, Vol. 61, 1933, p. 302). Here have been recorded temperatures of −32° C. in standard instrument shelters and −40° C. in the open.

The region occupied by this cold pole—incidentally, the scene of the recent outbreak of volcanic activity—is a strip 100 kilometers or so in width along the Chile-Argentina frontier between parallels 38° and 41°. It is traversed not alone by the north-south ranges of the Andes but also by subsidiary west-east ranges. Thus it is partitioned into deep valleys within mountain walls, which provide ideal reservoirs for the cold, heavy Antarctic air that descends from above at this latitude. From this region of normally high barometer the cold air naturally drains to surrounding regions of lower pressure. Of it Señor Bustos Navarrete writes: "The occurrences of very low temperatures are always accompanied by mighty invasions of polar air loosed from the Antarctic front. These enormous air masses, indicated on the meteorological charts by anticyclonic systems of high pressure, often enter the continent between latitudes 40° and 50° S., lingering at times in the region of Aysen, Chiloé, and Llanquihue on account of the natural resistance offered to their advance by the cordillera of the Andes."

In severe winters the cold waves that radiate from this cold pole frequently invade the central valley of Chile and the pampas of the Argentine.

AUSTRALASIA AND OCEANIA

Aridity in Australia. That the problem of aridity in Australia continues to command the attention of climatologists of that continent is demonstrated by the publica-

tion recently by John Andrews and W. H. Maze, of "Some Climatological Aspects of Aridity in Their Application to Australia" (*Proc. Linnean Soc. of New South Wales*, Vol. 58, 1933, pp. 105–120) and "Seasonal Incidence and Concentration of Rainfall in Australia" (*Proc. Linnean Soc. of New South Wales*, Vol. 58, 1933, pp. 121–124) and by Andrews of "Rainfall Reliability in Australia" (*Proc. Linnean Soc. of New South Wales*, Vol. 57, 1932, pp. 95–100). In the first of these articles the authors enumerate various definitions of deserts and summarize the methods devised by Transeau, Thornthwaite, Meyer, Lang, and De Martonne for the quantitative determination of intensity of aridity. The authors determined upon the use of the De Martonne formula, $P/(T + 10)$ (mean annual precipitation in millimeters, mean annual temperature in centigrade), apparently because it was the simplest of those that use mean monthly values of temperature and precipitation.

Their first use of the De Martonne ratio was—as originally intended by De Martonne—to produce a map showing annual conditions of aridity. The ratio was then applied to mean monthly values of temperature and precipitation, and twelve maps showing monthly conditions were prepared. Of these the maps for January, March, June, and October are reproduced and discussed. Finally, from the monthly computations the duration in months of the condition of aridity was determined and mapped. Here, the region exhibiting the "arid condition" for a period of eight or more months is considered arid. It is regrettable, since the authors made computations of the De Martonne ratio for each of the twelve months of the year, that they failed to make the map of annual conditions by summing up these monthly ratios, instead of on the basis of mean annual temperature and precipitation as they did, for in this way the consequences of seasonal concentration of rainfall would, to some extent, have been considered.

In "Seasonal Incidence and Concentration of Rainfall in Australia" five maps, four of which show the percentage of the mean annual precipitation falling in each of the four seasons—summer, autumn, winter, and spring—and the fifth the seasonal concentration of rainfall, that is the difference between the highest and the lowest seasonal percentage amounts, are discussed in three short paragraphs of text.

In "Rainfall Reliability in Australia" Andrews repeats the well known objections to the use of average annual rainfall as a generalization of precipitation conditions. He states that the mode (or value that occurs most frequently) is a more satisfactory value. The reliability of this most frequent rainfall value (M. F.) is determined as the ratio of the number of years in which it occurs to the total years of the record. These two new meteorological generalizations are used as bases for maps.

Climatological data are so meager in Australia that climatic maps of all sorts are mere generalizations, no details of local differentiation being possible except where actual acquaintance with the terrain permits interpolation. The maps presented by Andrews and Maze tell little more than maps of seasonal and annual rainfall and probably not so much as those based on any of the current quantitative classifications of world climate. The urgent need in Australian climatology is for more data, and until they are available climatic studies should probably be descriptive rather than quantitative.

The concluding statement in "Some Climatological Aspects of Aridity" is quoted as characteristic of the three articles. "The present-day climatic factor is the most important of the immediate causes of aridity. The dominant climatic character in arid regions is the length of the period in which most geomorphological and biological processes of fluvial regions are suspended or greatly curtailed because of the absence of an effective precipitation. Definite limiting values are suggested for the efficiency of precipitation (in monthly means) and for the critical length of the arid period. The authors suggest, as a basis for discussion, the definition that regions of aridity are regions of markedly intermittent and strongly contrasted geomorphological and biological processes which are controlled in their occurrence by the length of the

period of insufficient precipitation; these arid periods are of such length and recur so frequently that the processes associated with them are dominant in determining the cultural and natural landscapes."

C. W. THORNTHWAITE

Upwelling on the West Australian Coast. To explain the desert character of large parts of the West Australian coast Köppen has advanced the theory of upwelling of the coastal water. His argument gave rise to a recent investigation of the problem by Gerhard Schott (Auftriebwasser an den australischen Westküsten? Ja und Nein! *Annalen der Hydrogr. und Marit. Meteorol.*, Vol. 61, 1933, pp. 225–233).

Material collected by the Meteorological Office in London from 1921 to 1932 for the region between Fremantle and Port Darwin was combined with reliable data of earlier observers in sets of isothermal (surface-water) current and wind maps showing the conditions prevailing during the four seasons. The maps cover as far as 1200 miles from the coast. Two analogous sets of maps depicting conditions off the west coast of South Africa permit of convenient comparison with a region of undisputed upwelling. These maps make clear that only in autumn and off the northwest coast is there a temperature anomaly that may be ascribed to upwelling. A decrease from west to east of 3° C. in the surface-water temperatures is apparent between North West Cape and Broome, especially marked along the Ninety Mile Strand. Sporadically in winter, low temperatures, probably associated with strong easterly winds, have been recorded about North West Cape. The period of perceptible upwelling coincides with the period of offshore trade winds. Quantitatively, the phenomenon is too small to stand comparison with that off the west coast of South America or of South Africa. It produces neither typical climatic effects on land nor characteristic fogs at sea. The existence of coral reefs, mangroves, and pearl fishing also proves the insignificance of the phenomenon. Irregular and especially unreliable rainfall is perhaps an effect, but the only perceptible one. Professor Schott's answer to the question "Upwelling or not?" is 90 per cent "no" and only 10 per cent "yes."

The Köppen argument can be met with the following consideration. That part of the Australian west coast where rainfall is conspicuously deficient extends from Geraldton (about 28° S.) over North West Cape and the Ninety Mile Strand towards Broome (18° S.). There are two reasons for this. The low flat coast does not cause air to rise, and the dry southeast trades maintain almost uninterrupted control over this section of the coast throughout the year. Swanland, to the south of the critical area, receives moisture-bearing winds from the westerly wind system. North of the critical area the rainfall increases because of a monsoonal effect from westerly and northwesterly winds—an effect comparable with, though more regular than, that produced occasionally on the northern coast of Peru when northerly and northwesterly winds lead to the development of the Niño Current (R. C. Murphy: The Humboldt and Niño Currents, *Geogr. Rev.*, Vol. 22, 1932, pp. 148–150).

As a result of his findings Schott is inclined to shift the emphasis from purely oceanographic to purely meteorological causes, arguing that "a trade-wind coast is liable to be dry if and as long as the dry trade winds control the movements of the air."

Schott also attempts to answer the question as to why there is so little upwelling on the Australian coast. A comparison with thermal conditions on the west coast of South Africa reveals, first of all, the fact that subtropical convergence (i.e. contact of subtropical waters from the south equatorial current with the waters from the west-wind drift) lies at latitude 20° to 25° S. in the Indian Ocean and at latitude 33° to 37° S. in the Atlantic. This difference produces far-reaching effects, especially in the southern winter. In the Indian Ocean the waters of the west-wind drift have no alternative but to follow an onshore course towards Cape Leeuwin and then an

eastward one around North West Cape. In the South Atlantic, however, a branch of the Agulhas Current finds even in winter the possibility of wedging its way between the southern tip of Africa and the west-wind drift and advancing in a general westerly and northwesterly direction, i.e. following an offshore course. There are two reasons for this interference by the Agulhas Current: first, its own energy, which is powerful enough to push westward even in the face of strong westerly winds; second, the small east-west extent of South Africa, which is only one-third of that of Australia.

Summer conditions on both coasts do not lend themselves with like readiness to a satisfactory explanation. In summer the West Australian Current bears great resemblance to the Agulhas Current. But, while the latter reaches its maximum strength in summer, owing to the seasonal decrease of the west winds, the West Australian Current is generally weak and has a tendency to develop a striking number of onshore branches, evidently under the influence of frequent onshore winds.

H. A. BAUER

Land Utilization in the Hawaiian Islands. In the Territory of Hawaii agriculture is facing the common problems of overproduction and the use of marginal lands. In the case of sugar, a crop raised commercially by reason of a protective tariff and the availability of imported labor, the outlook is precarious because of the uncertain status of these two factors. The pineapple industry, which finds optimum natural conditions in the islands, is in a state of depression through overexpansion. On the other hand, the people of the Territory depend largely on imported meat and rice, vegetables, and other agricultural products that could be raised there. This suggests that there is need for a readjustment of the agricultural economy of the Hawaiian Islands.

It is in connection with this problem that J. W. Coulter of the University of Hawaii has prepared his monograph "Land Utilization in the Hawaiian Islands" (*Univ. of Hawaii Research Publs. No. 8*, 1933). Maps indicating the utilization of the land in 1906 and tables and maps for 1930 show that many changes have taken place. The 1930 maps are given in some detail. A section of the report is devoted to a discussion of the conditions under which the leading crops are grown.

With regard to sugar, Dr. Coulter finds that in many cases cane is grown on distinctly marginal lands. In proof, crop records from various plantations are quoted. Frequently poor land lies within the area of a good cane field and is cropped because it is easier to treat the field as one unit. Because soil and climatic conditions vary greatly within short distances, only a detailed survey will reveal the areas of optimum conditions for sugar-cane culture. Dr. Coulter describes one of the more favorably located plantations, at Waipahu, on Oahu, in *Economic Geography* for January, 1933.

POLAR REGIONS

Oceanographical and Meteorological Results of the "Sedov" Expedition of 1930. The entire number (173 pages) of Volume 1 of *Transactions of the Arctic Institute* (Leningrad, 1933) is devoted to the "Scientific Results of the Arctic Expedition on the *Sedov* in 1930: Hydrology and Meteorology." The expedition covered the eastern part of the Barents Sea and the northern part of the Kara Sea, with extensive surface observations and 25 oceanographic stations, the latter being taken in the northern Kara Sea. The arrangement of the stations permitted a ready evaluation of the collected data by two latitudinal and two meridional profiles of several hundred miles each, extending approximately between the parallels of 76° N. and 81° N. and between the meridians of 60° E. and 90° E.

Surface temperatures and surface-water samples were taken every hour, or prac-

tically every 10 sea miles, during the entire trip, so that a complete picture of surface conditions could be constructed. The oceanographic data included temperature, salinity, dissolved oxygen, alkalinity, and hydrogen-ion concentration; in addition, a full chemical analysis of the sampled water was made.

Professor W. J. Wiese, assisted by A. F. Laktionov, presents an exhaustive discussion of the tabulated material together with some 47 profiles and surface maps. Ice conditions are described and interpreted in a special chapter containing one general and four special ice charts. Some 202 soundings and a continuous meteorological record amplify the elaborate program.

While not revealing any really new Arctic phenomena, the findings of the *Sedov* have added considerably to a more precise knowledge of the circulation of Arctic waters, especially of the rôle played by river water and melting ice. The advance of Atlantic water from the polar basin into the northwestern part of the Kara Sea is clearly exhibited by a middle layer of higher temperature and salinity, while nothing seems to indicate a penetration of cooler water from the depth of the polar basin. Summer conditions, in contrast with the homogeneity of winter, are characterized by several minohaline tongues (between 10 and 25 meters) of southern origin, clearly outlined by the trend of surface isohalines and remarkably well exhibited in the vertical distribution of salinity. The westernmost of these minohaline areas, known as the Ob and Yenisei Current, had been recognized before; the second, pointing to 60 miles north of Novaya Zemlya, was first observed by the *Sedov* Expedition of 1929 (Sedov Current); a central area of diminished salinity has its apex in the region of the newly discovered Wiese Island (St. Anna Current); while the easternmost minohaline tongue, extending almost to Schmidt Island, has its source in a northward surface current, to which the name Eclipse Current has been given.

Since many of the oceanographic stations were established in or at the edge of extended ice areas, definite conclusions could be drawn as to the striking increase of alkalinity by the melting of ice in summer. When one considers the as yet problematic stage of ice forecast for the Barents and Kara seas (N. N. Zubov: The Circumnavigation of Franz Josef Land, *Geogr. Rev.*, Vol. 23, 1933, pp. 394–401), the practical importance of the ice survey as made by the *Sedov* Expedition needs no further comment.

H. A. Bauer

PHYSICAL GEOGRAPHY

The Greatest Daily Tide. Along the shores of most tidal waters there are two high and two low waters in a day. This means that the rise of the tide occupies a period of about six hours and the fall likewise a period of six hours. There are some places, however, where there are but one high water and one low water in a day. At such places, therefore, the tide rises for a period of about twelve hours and falls for a like period. This daily type of tide is not of wide occurrence. A glance at a map of types of tide (see, H. A. Bauer's "Types of Tide" map, *Geogr. Rev.*, Vol. 23, 1933, facing p. 266) shows such tides to occur in certain regions on the Gulf of Mexico, in Alaska, in the Philippine Islands, on the coast of China, and in a few other scattered localities. And as a rule the range of the tide at such places is small, a matter of only a few feet at most.

Observations made by Russian and Japanese investigators, which have come to light recently, show that the Okhotsk Sea is to be added to the regions in which daily tides occur. And what gives these tides special interest is that they have large ranges. The largest range occurs in Penzhinskaya Bay, which forms the northeastern head of the Okhotsk Sea. In the upper part of this bay, at Cape Astronomicheski, the Russian Hydrographic Department secured a month of observations. During this month there were only a few days in which two high and two low waters occurred; the greater part of the time there were but one high and one low water

each day. The average range of the tide was 22 feet, the average range of the daily tide was 28 feet, and on one day the range was 37 feet. At this point therefore is found the greatest daily tide in the world, as far as known.

H. A. MARMER

GEOGRAPHICAL NEWS

The International Geographical Congress, Warsaw, 1934. The International Geographical Congress of 1934 will be held in Warsaw, Poland, from August 23 to 31 inclusive, under the presidency of Dr. Isaiah Bowman. The organization of the Congress is in the hands of a Polish Executive Committee of which Professor Eugene Romer is chairman and Professor Stanislas Pawłowski general secretary.

The United States National Committee of the International Geographical Union, under the chairmanship of Professor Douglas Johnson, has issued a circular urging American geographers to make "a special effort to send to Warsaw a large and representative group." It is also suggested that the American delegation should arrange a special cartographic exhibit at Warsaw as a compliment to Professor Romer. Attention is directed to the fact that the meeting in Warsaw not only offers in the official excursions an unusual opportunity to American geographers for the study of the physical and human geography of Poland but also provides the occasion for visiting other parts of Central and Eastern Europe and the Near East. Official excursions preceding the Congress (August 13–21) are planned to Polesia, to Podolia and the eastern Carpathians, and to Cracow and the High Tatra; succeeding the Congress (September 2–9) to Wilno and its region, to Pomerelia and the Baltic coast, to the Łysogóry Mountains and Polish Silesia, and to the valley of the Vistula.

The sessions of the Congress will be open to papers and discussion on the following subjects: cartography (representation of relief on maps; map projections and their application; account of topographic and cartographic work performed by government bureaus of different countries and by private cartographical institutes; exhibition of publications on cartography); physical geography (results of investigations of Quaternary deposits; the nature of cuestas; morphometric methods and their application; the classification of climates; the classification of rivers according to the coefficient of flowing-water volume); human geography (man in the geographical landscape; colonies, emigration, acclimatization; influence of geographical environment on air and motor routes; localization of industries; urban geography; determination of regional boundaries in economic geography, graphical methods of showing geographical regions); prehistorical and historical geography, and the history of geography (the reconstruction of the geographical conditions of the prehistoric habitat; changes in landscapes in historic times; unpublished and rare cartographical documents); landscapes (transformation of landscapes; concept of geographical regions; bases of the delimitation of regions); and methods in teaching of geography (the teaching of regional geography; laboratory work, exercises, and excursions as means of teaching; the application of the comparative method).

In addition there will be discussion of the problems studied by commissions appointed at the meeting in Paris in 1931: the rural habitat, aerial photography, topographic and cartographic work, erosion surfaces, historical cartography, the study of plant and animal relationships in mountains, the study of climatic variations, especially in historic times, and the study of overpopulation in relation to geographical and regional conditions.

Membership in the Congress is open to any person engaged in scientific research in the field of geography or interested in its applications: persons not geographers but who have geographical interests or who represent institutions not primarily geographic but that have large geographical interests (such as federal and state geological surveys, departments of agriculture, museums of natural history, etc.) are welcome. Relatives accompanying members may also be enrolled in the Congress.

Admission as a member of the Congress will be granted upon filling in the form of application for membership and upon payment, direct to the Warsaw secretariat, of the fee of 40 zlotys (approximately $7.50 at current exchange) and 10 zlotys for each person accompanying the regular member. Application blanks may be secured from the Secretary of the National Committee of the United States, Mr. W. L. G. Joerg, American Geographical Society, Broadway at 156th Street, New York City. The United States government has taken official cognizance of the International Geographical Congresses, and arrangements will be made for official representation by a limited number of delegates. For this purpose it is requested that Mr. Joerg be notified of those planning to be present at Warsaw.

The address of the Congress and its secretariat is High School of Commerce (Szkoła Główna Handlowa), Rakowiecka 6, Warsaw.

"**Pacific Affairs.**" With the March, 1934, number *Pacific Affairs*, the organ of the Institute of Pacific Relations, Honolulu, Hawaii (editorial offices in New York), becomes a quarterly under the editorship of Owen Lattimore. An editorial gives an excellent statement of the place and purpose of the magazine: ". . . it will serve the function of a survey of those facts and issues in the Pacific world which have a significance reaching beyond national frontiers. It is devoted more especially to the exploration of those forces and tendencies in the Pacific countries which must be understood to interpret the passage of events both within nations and between nations."

The new *Pacific Affairs*, which appears in attractive guise, opens with an article entitled "The Next War—Europe or Asia?" by Arnold J. Toynbee. The editor contributes "Mongolia Enters World Affairs," an article with a clearly defined geographic basis—"the relation of continental values to maritime values in the destiny of Asia." Other articles deal with "The Economic Crisis and Netherlands-India," "Japanese Emigration to Brazil," and "China's Greatest Book."

OBITUARY

Knud Rasmussen. In the generation that is passing Rasmussen was Denmark's candidate to rank with Peary of the United States and Nansen of Norway among those who will maintain a front rank in the history of exploration as long as the standards of judgment shall be at all similar to what they are now. Peary excelled as a deviser and user of effective technique in northern travel as well as through the accomplishment of individual journeys. Nansen's were the brilliant conceptions applied to the sea, its life, and its conditions. Rasmussen's is the foremost rôle as portrayer and interpreter of humanity in the northern lands. He started with what he himself calls his "Excursion to Lapland" in 1901 (published in 1907 as "Lapland"). His chief work lay with the Eskimos, who were thrice his own people: he was born among them on June 7, 1879, and he grew up with them; he was partly of their blood; he was their best interpreter and advocate, later their successful friend and protector.

Formally Rasmussen began his work as explorer when he became ethnographer of the Mylius Erichsen expedition of 1902–1904. It is confusing to attempt a census of his various expeditions thereafter. Much simpler and really more accurate is it to say that he spent in the Arctic the greater number of his winters and most of his summers from 1902 until his death, which occurred at Copenhagen December 21, 1933, from an illness contracted through ptomaine poisoning some weeks earlier during a large-scale summer expedition to the East Coast of Greenland.

The most important of Rasmussen's scientific work was done on expeditions that occupied roughly two-thirds of his last thirty years and that covered every shore of Greenland except the northern east coast that was notably elucidated during the

same period by his early commander Erichsen and his associates Mikkelsen and Koch. Most spectacular was his three-year expedition, 1921–1924, from Greenland across Arctic America to Bering Strait (see the report in the *Geogr. Rev.*, Vol. 15, 1925, pp. 521–562). That expedition was also one of his most successful—in the good and voluminous results obtained by him and his staff.

Through the love of Denmark's people, the admiration of her scientists, and the confidence of her government Rasmussen was able not merely to get support for his personal work but to organize larger or smaller staffs for his expeditions as circumstances dictated; through his success he was able to inspire the organization of complementary expeditions led by others. The love and admiration of the Eskimos secured for him better local support in Greenland than was possible to any other leader or organizer.

Rasmussen's command of the language, which is one for the Eskimos from eastern Greenland to western Alaska, enabled his 1921–1924 journey across Arctic America similarly to enlist beyond any previous expeditions the support of the Eskimos whose countries he traversed. On that journey he was, in 1923, almost certainly the last possible European to come in contact with Eskimos (perhaps ten or twenty) who had never before that time seen a white man. This occurred in the region southeast of Coronation Gulf. That opportunity, and also every other that had a linguistic, folkloric, or in any way ethnographical side, he utilized to the utmost, through his sympathetic personality as well as through his full command of the language.

Some insight into his personality and the fundamental spirit of his work may be gained by the English reader through his few books that have been translated into English. "The People of the Polar North" (London, 1908) was "compiled from the Danish originals" "New People" and "Under the Lash of the North Wind." "Greenland by the Polar Sea" (London, 1921) is a fair translation from the corresponding Danish. "Across Arctic America" (New York and London, 1927) is something between an abridgment and a juvenilization of the magnificent Danish "Fra Grønland til Stillehavet" (From Greenland to the Pacific). "Eskimo Folk-Tales" (London, 1921) and "The Eagle's Gift" (New York, 1932) are good renditions. Fortunately much of Rasmussen's later scientific work and that of members of his expeditions was published originally in English, either in the Danish *Meddelelser om Grønland* or as independent publications. To the *Geographical Review* he contributed "Explorations in Southeastern Greenland: Preliminary Report of the Sixth and Seventh Thule Expeditions" as recently as July, 1933.

The personal loss at the death of an explorer has seldom within our time been felt so keenly or through so many countries. The scientific loss in what might easily have been another twenty years of activity is irreparable. Rasmussen is said to have left behind great quantities of manuscript notes. Here are difficulties, for the writing is fine and not always easily decipherable, the languages are Danish and Eskimo interchangeably, there is much abbreviation, and a great deal must have been left to the memory of the recorder. However, Thalbitzer, though most famous, is but one of many splendid Eskimo linguists now available in Denmark, some of whom were members of Rasmussen's expeditions, others associates and close friends. We can hope for a good deal if, as doubtless will be the case, the manuscripts are placed in their hands. Then may the scientific world continue long to receive from year to year new fruits of Rasmussen's work.

VILHJALMUR STEFANSSON

GEOGRAPHICAL REVIEWS

Political Aspects of Mineral Wealth

Elements of a National Mineral Policy. Prepared by The Mineral Inquiry. vi and 162 pp.; index. New York, 1933. 9 x 6 inches.

William P. Rawles. **Provisions for Minerals in International Agreements.** *Political Sci. Quart.*, Vol. 48, 1933, pp. 513–533.

The Mineral Inquiry is the name of the most recent of the committees that, with Dr. C. K. Leith as chairman, have been carrying forward the important work of making "factual studies of the mineral resources of the United States and the world in their political and international relations." This volume marks a distinct advance in both consideration and treatment of a study begun, in this country, during the World War. It contains first a reprint of the general summary prepared, at the close of the Council on Foreign Relations conference, by Dr. Leith "with the aid of The Mineral Inquiry and a number of the more active participants in the conference" and presented in Dr. Leith's own inimitable and stimulating style. This relatively brief summary has been helpfully annotated by references to the 19 individual articles that make up the rest of the volume and represent contributions by mining engineers and geologists of wide foreign experience, such as Duce, Read, and Weld; by specialists of the Bureau of Foreign and Domestic Commerce, such as Furness and Frey, and of the Geological Survey, such as Hewett; by economists, such as Voskuil, Orchard, Skelton, Noyes, and Tucker; by mining engineers and geologists with special knowledge of various aspects of our domestic problems, such as Eavenson, Marshall, Notman, Barbour, and Oliver; by a lawyer, writer, and international observer, such as Norton; and by the secretary of The Mineral Inquiry, Rawles. This treatment gives a more comprehensive idea of the complexities of, and differing viewpoints on, the problems involved and of the probabilities of their solution than would be possible in a book of equal length by a single author. Wisely, we believe, "no effort has been made to harmonize the contributions."

Passing for the moment the varied and useful contributions of the mining engineers and geologists, whose life work lies with minerals and who thus may be sometimes too close to the picture, it will be noted that the contributions of the economists are a particularly helpful addition in the consideration of the problems involved. This has been recognized in the annotations, which likewise refer to the incisive and illuminating comments of Norton as striking "a stimulating note indicating that differences in value are not merely economic but also in part psychological, and pointing to a wise conservatism and the necessity of careful consideration of the opinions of others."

Treaty rights covering minerals are also referred to in the annotations, with the penetrating observation that "regulations and administration are often more important than nominal treaty rights or public law." Reference is made in this connection to a report by Mr. Rawles in course of preparation with the assistance of the Department of State, which has now appeared, as noted above, in the *Political Science Quarterly* for December last. In this Mr. Rawles finds that the famous San Remo Agreement was "a few years after the signing . . . regarded as not being in force but for a time it was a document of tremendous importance." He concludes, with regard to treaty provisions that relate to minerals, that, while "few of them have been of much importance to the world for any great length of time," they seem to him to indicate, on the whole, the growth of a "philosophy . . . that bids fair to guide future political thought regarding minerals in connection with international affairs." It is, however, to be noted with respect to the treaty that he rightly regards as the most advanced step, namely the convention and protocol for

the abolition of import and export prohibitions and restrictions on mineral raw materials, to which the representatives of 30 nations had indicated adherence but which was ratified by only seven, that Great Britain and the United States gave notice of withdrawal in June, 1933. Evidently this was after the preparation of the article, because the fact of the withdrawal of these two nations—which together control, as is pointed out in "Elements of a National Mineral Policy," something like three-quarters of the world's raw mineral materials—is covered by a footnote inserted by the editor.

No small part of the advance in the consideration and treatment of this many-sided subject in "Elements of a National Mineral Policy" is due, in the opinion of the reviewer, to the ameliorating influence of time and to a greater recognition of the human element, forced by the events of the last few years. In the war years, which marked the birth of studies of this character in the United States, the central and dominating idea was the importance of minerals in war. The early years after the war were still dominated by war ideas of mineral uses. The note among all nations was then: "We must prepare; we must safeguard." As Duce aptly points out, "so-called military reasons . . . led to nationalistic excesses in the endeavor to secure foreign deposits."

The fundamental error of these post-war views and of the excesses growing therefrom—and likewise an essential distinction between peace-time development and war-time needs—is well illustrated, as I believe has been pointed out elsewhere, in the case of petroleum. So strongly was the importance of petroleum and petroleum products impressed by the events of the war upon, for example, British officialdom that it developed the idea that it was necessary and desirable that all petroleum deposits in the British Empire be conserved for British use and that no one but the British should be permitted to develop them. The first Lord Cowdray, one of the ablest, most patriotic, and most farseeing of Britons, opposed this idea, pointing out that it was neither sound nor reasonable. Locking up the resources of the Empire, he said, is of no value as a precautionary measure, because an undeveloped deposit is useless in time of war, and so great is the extent of the British Empire and so vast are the sums of money that would be required for proper testing and development of its deposits that, in his opinion, the British Empire would most effectively accomplish its own ends by saying to the world: "Welcome. We are delighted to have you spend your money in our territory seeking oil or any other mineral deposits." In times of peace the money so spent helps the country, and in the event of war the utilization of the developed deposits is determined not by the nationality of the capital invested in the development but by the nationality of the region in which the deposits lie. This early post-war fever has now largely run its course; remnants of it still remain, but for the most part, as far as the British Empire is concerned, only in parts of the Empire where they are relatively of no importance, and these remnants will, no doubt, also yield to the rule of reason.

Much less emphasis is placed on war uses in the present volume than heretofore, and where this aspect of minerals is treated it is much more nearly in its true perspective. Further progress along the line of distinguishing between developments in peace time and the utilization of minerals in war is foreshadowed by the recognition by many of the contributors to this volume that fear is one of the most important of the basic causes of the problems that have developed. It is well pointed out by Duce that "fear, often groundless, is the first factor to be dealt with in freeing the mineral industry from its shackles."

This note is in happy contrast with that of earlier reports on this subject, which suggested that mineral deposits in the territories of so-called backward nations should be developed by force if amicable arrangement failed. If force was to be the means of securing development, there was good ground for fear, and the growing recognition that one should substitute reason for fear marks a notable advance.

Another cause for the advance in the treatment of this subject is that in the early post-war days there was, with regard to some important minerals, a cry of exhaustion, while today overproduction, although adding its quota of problems, makes it possible in this respect to formulate more rational programs and policies. On the point of adequacy of the world's mineral resources one finds Leith expressing the view that "for the world as a whole, mineral supplies are so large that there is little need for concern about early exhaustion; but for each nation there is danger of early exhaustion of particular minerals." Duce, bringing home the disturbing effect on supplies of a rise of price and its stimulation to the discovery of new processes, says: "Let me add . . . my extreme skepticism on the subject of the exhaustion of reserves. Man has a disconcerting habit of finding new processes making available unreckoned deposits, while a small rise in price has a disconcerting way of leading to an embarrassing superfluity." Hewett more cautiously states: "The demand for controlled production is allied to a widespread conviction that there is abundance of materials. Undoubtedly, this has been true since about 1925, but it may be debated whether it will long continue. If the sources of minerals behave under exploitation during the next few decades as they have during recent decades, the method used to control production must provide for constant accessions of new sources and for research in technique, both of exploitation and discovery, to bring them to production. To assume that known sources of production will be ample to supply the needs of minerals for the next few decades, at current rates of production, would almost certainly lead to serious shortages. On the other hand, several efforts to control mineral production in Europe by the use of cartels have collapsed because marginal producers have been able by improvements in technique to capture markets." Oliver quite rightly stresses, in the case of oil, that there is no "oversupply" in the sense that it warrants or justifies waste and that the oil problems need to be approached along this line of sound reason rather than along the line of fear that our oil supplies will be exhausted day after tomorrow.

It is this undercurrent of recognition that progress in the solution of the multiple problems that beset minerals in their national and international relations is to be made by the application of reason and common sense rather than along the pathways of fear and the added recognition of the humanitarian features of the importance of employment and of the inexorable law that for any venture to be a real success there must be compensating advantages to all concerned that make the present work a stimulating advance in the treatment of this many-sided problem.

A. C. VEATCH

SURVEY OF WORLD AGRICULTURE

World Agriculture: An International Survey. A Report by a Study Group of Members of the Royal Institute of International Affairs. vii and 314 pp.; diagr., index. Oxford University Press, London, 1932. 12s. 6d. 9½ x 7 inches.

"World Agriculture" is the second notable contribution upon an economic question of great immediate importance to come from the Royal Institute of International Affairs within recent months. "The International Gold Problem" was published early in 1932. It has been characterized as the most significant work on the gold problem that has appeared in the past decade or so. "World Agriculture" treats a subject equally vital and complicated and in its general excellence is a worthy companion volume.

As the subtitle indicates, the present work is the product of no single mind. A first draft was prepared and submitted to a considerable number of authorities in England and abroad, and the comments received were either incorporated in the final published text or assembled in an appendix, of particular value since many of the comments are at variance with the conclusions of the study group. This method

of preparation explains some of the book's outstanding virtues: it represents a broad cross section of many shades of opinion; every proposition is subjected to critical analysis from several angles; and there is no attempt to agree upon some simplified solution for present world difficulties.

On an early page it is stated that "the purpose of this book is to offer some explanation of the why and the wherefore of the disturbing and apparently senseless situation in which producers of essential human requirements are faced with disaster while others starve for want of the produce stored in barns and warehouses." It is perhaps the most paradoxical situation of the present age and one that must puzzle not only the economist but every thoughtful person.

The fourteen chapters of the book fall into three rather distinct groups. In the first group there is an analysis of the agricultural depression and of its causes; in the second group agricultural conditions in the more important areas of the world are summarized; and in the final group there is a critical presentation of the various efforts that have been made to end the depression.

In their explanation of the causes of the fall in agricultural prices the authors are inclined to minimize the importance of a rapidly increasing production since, as they point out, the increase in the last decade has actually been less than it would have been if the pre-war trend in acceleration had been maintained. In their opinion price declines have been due not to such increase but to overproduction in relation to the diminishing purchasing power of consumers, which in turn is traced primarily to the breakdown of the mechanism of international exchange—a point of view that will undoubtedly be received sympathetically by certain of the monetary authorities in this country. It seems to the present reviewer that more consideration might well have been given to the rate of world population increase in its relation to agricultural production as a significant influence in the depression. Two chapters are devoted to price movements since 1873 and to the effect upon the agricultural class of the changing price levels of individual commodities. Into this discussion there are introduced a number of economic questions of a highly controversial nature quite beyond the scope of this review.

An attempt is made to measure from the inadequate data available the returns to agriculture in terms of the returns from other economic activities. Though no definite conclusions are possible, it seems clear that in material gains agriculture is in general on a lower level than the manufacturing industry, trade, or any other occupation of the town. As compensation, the farmer has had more security and stability until they were destroyed or threatened by the present depression. In an appendix Sir Josiah Stamp makes the case against agriculture even stronger when he states that "the world as a whole and over a given length of time has almost certainly been fed below cost price for the last 100 years, if one takes into account the proper elements of costs"—an opinion that receives support in the fact that practically all the great migrations have occurred in agricultural groups.

Geographers, especially in America, have given considerable attention in the last few decades to the mechanization of agriculture. The effects of the machine in extending agriculture into marginal lands and in increasing production have been recognized, but the depression has raised a question of the economic soundness of large-scale agriculture, for it has been the mechanized farms, with their burden of fixed overhead charges, that have felt the fall in prices much more severely than the peasant farms, dependent mainly upon the labor of the immediate family.

In the second group of chapters there are brief but illuminating descriptions of conditions of agriculture at the present time in the United States, Argentina, the British dominions, Europe, the Orient, and tropical and subtropical countries. This is one of the most interesting sections of the book for the geographer, since there is less emphasis upon abstract economic questions and more discussion of peoples and of the prevailing trends and national aims in agriculture. It is in this section that the particular problems of agriculture in each of the areas are presented.

In the final group tariffs, quotas, monopolies, embargoes, bounties, stabilization schemes, price pegging, valorization, national organizations, international organizations, marketing bodies, output restrictions, and all the other plans that have been resorted to since the World War in an effort to halt the decline in prices are examined. The record is not encouraging. Not only have all the efforts failed to relieve the conditions against which they were aimed but in most cases they have further aggravated those conditions. Restriction schemes have encouraged the marginal producer and have invited retaliation from groups or nations upon whom they have worked a hardship. The normal function of price in equating supply and demand has been greatly restricted or destroyed.

"World Agriculture" closes with the analysis of the relief schemes, and the authors do not offer any panacea of their own. The reader is left, however, with a conviction that planned agriculture cannot succeed piecemeal. It must be international and complete and applied not to one commodity but to all commodities. Such world-wide control clearly will not be practical politically for a long time to come. If there is any hope that it may be attained ultimately, present hardships are to be borne as necessary sacrifices. But if such a prospect is too remote, the question arises whether it might not be better to abandon all artificial restrictions, center attention upon the restoration of a stable medium of international exchange and credit, and trust price eventually to reassert its function of equating supply and demand. Such procedure, however, would undoubtedly bring much hardship before equilibrium was restored, and it is scarcely to be expected that local or national interest will abandon any substantial portion of the population to the harsh operation of economic law even on the promise of the eventual correction of existing ills.

JOHN E. ORCHARD

TRENDS IN GREAT CITY EVOLUTION

R. D. MCKENZIE. **The Metropolitan Community.** xi and 352 pp.; maps, diagrs., index. (Monographs: Recent Social Trends in the United States.) McGraw-Hill Book Co., Inc., New York and London, 1933. $3.50. 9¼ x 6½ inches.

The key to Dr. McKenzie's metropolitan community is the development of motor transportation in the last 30 years. The railroads set the main structural outline of settlement of the United States as a whole, and this is likely to remain; they did not, however, change the traditional local pattern; in this respect the effect of the motor vehicle has been revolutionary. Railroad and telegraph are primarily long-distance means of communication; motor and telephone are primarily local (it is still too early to forecast the place of airplane and radio). The metropolitanism of today differs from that of the railroad age in complexity and mobility. The horizon of the city has been extended; it includes formerly independent towns and villages besides new ones it has created and even rural areas. The United States census of 1930, with its improved if not entirely satisfactory criterion for the metropolitan district, recognized 96 metropolitan units, and these contained 1566 separate incorporated places, of which 889 were of urban rank.

Urbanism has not only increased; it has changed in character. Half the population of the United States now lives within daily access of a great city (more than 100,000 inhabitants); in 1900 there were 38 great cities; in 1930 no less than 93. Growth has been more rapid in territory adjoining the larger cities than in the cities themselves (note the interesting growth profile of Chicago, p. 178, and the map, p. 177). Population "is tending to concentrate more and more in large regional aggregates. In every such aggregate, the population tends to subdivide and become multinucleated in a complex of centers that are economically and socially integrated in a larger regional unity."

The new metropolitanism differs from that of former times in that it is the product of contact and division of labor rather than of geographical isolation. While diversity appears within the metropolitan unit through division of function—the dominant city, for instance, tends to take over finance, manufacturing to be dispersed—metropolitan districts as compared with one another tend to uniformity in economic and institutional structure. Such uniformity is in part brought about or intensified by the growth of national organizations, economic and social, of the chain type (compare the Federal Reserve Bank pattern organized in 1913). This is in line with the maturation of settlement for the country as a whole. Such indexes as education (teachers, school expenditures, college students, newspaper circulation, illiteracy) and transportation and communication (post-office receipts, motor vehicles, surfaced-road mileage, telephones) reflect the trend towards cultural leveling (see table, p. 120). The metropolitan regions are tending to integration, with New York City and Chicago as supercenters. "Up to 1920, the leading factor making for population concentration was the centralization of industry. . . . The census of 1930 with supplementary evidence now available indicates that the factors involved in metropolitan growth during the last decade were primarily commercial and institutional."

The new metropolitanism involves many new problems arising from such factors as the changed physical structure of the city (new type of building construction—large apartments, skyscraper office buildings), suburban drift with its selective effect on the population elements, excessive developments of new urban land on the "penumbra" of the urban region, creation of "blighted areas" between the new developments of center and periphery, municipal tax burdens, pressure on transportation, and the peculiarly acute problem of government of the heterogeneous elements in the community.

Dr. McKenzie's sketch of the form and functions of the new metropolitanism is stimulating and suggestive and an admirable "frame of reference for further research" in a problem of great complexity. Several collaborators in special fields have contributed chapters to the volume. To mention two: R. E. Park and Charles Newcomb have written on newspaper circulation and metropolitan regions (their map is reproduced by R. E. Dickinson on page 283 of this number of the *Review*); and J. Rowland Bibbins has an interesting chapter on the "economic topography" of the city.

A Social History of Rural New York State

Ulysses Prentiss Hedrick. **A History of Agriculture in the State of New York.** xiii and 462 pp.; maps, ills., bibliogr., index. New York State Agricultural Society, 1933. $3.00. 9¼ x 6½ inches.

"The changing social scene in rural New York, people, not things, have lured the author. He has tried to give an account . . . of communities of farmers shaping the destinies of their common life as they took possession of a new land, . . . of changes and movements which have multiplied the conveniences and pleasures of farm people." These interests have affected the choice of material in many ways, for both text and illustrations. The professional historian would not ordinarily turn to Irving, James Fenimore Cooper, and Longfellow for descriptions of rural life, though Cooper and Irving have a certain status as near-contemporary sources for some of the incidents involved. The full-page reproduction of a railway cartoon entitled "A Kiss in the Dark" is evidently to be justified by the author's interest in people rather than in things. About one-fifth of the text is frankly devoted to general social problems—country life a hundred years ago, country food and drink, some curious interrelations of religion and agriculture, and the printing press and the farmer.

The author discloses a notable capacity for social history. He creates an atmosphere that is usually lost in strictly professional work, and his intimate knowledge of agriculture is revealed in the vivid contrasts drawn between the agricultural methods in each of the primary stages of development. The sketch of the development of agricultural machinery is interesting and very adequately illustrated, but the author is concerned only with the general reader. For this reason, too, less attention is given to the development of agriculture after 1880, when the general character of rural life comes more definitely within the limits of the general knowledge of the present generation.

Although the author has acquitted himself rather well in the accomplishment of the task to which he addressed himself, the volume discloses some of the weaknesses of this concept of social history. History cannot concern itself merely with people and their interests. Whether we find them interesting or not, things have a disconcerting way of forcing themselves upon our attention, and most especially in respect of agriculture. The rather disdainful attitude of the author toward things tends therefore to produce a picture of agriculture that is as incomplete as the play of "Hamlet" with Hamlet himself left out. Of all our occupations, agriculture is the most minutely and most delicately conditioned by its geographic environment. A good farmer must have an intimate knowledge of many things, and this fine craftsmanship of the farmer is almost completely misunderstood by the average city dweller of today. Even if the needs of only the general reader are to be considered, some description of primary soil types and climatic differences would not be out of place. The achievements of modern geography are too substantial to justify the implication that these problems of adaptation to nature are mere dry-as-dust professional material. Nature can be made no less interesting than persons.

ABBOTT PAYSON USHER

A GUIDE TO THE AMERICAN SOUTHWEST

N. H. DARTON. **Guidebook of the Western United States. Part F: The Southern Pacific Lines, New Orleans to Los Angeles.** vii and 304 pp.; maps, diagrs., ills., bibliogr., index. *U. S. Geol. Survey Bull. 845*, 1933. $1.00. 9 x 6 inches.

The Geological Survey and N. H. Darton have again earned the gratitude of travelers of scientific tastes by the preparation and publication of the sixth guidebook of the western railroad lines. The general plan of these books is to present a readable description of the geology of a strip of country on either side of and, generally speaking, within sight of the railroad track. In this guide topography and geology are shown on 29 folding maps that cover, section by section, the approximately two thousand miles between New Orleans and Los Angeles. In places there are two main lines, and on this account much greater area is shown on some of the maps than in the earlier guidebooks: the text, likewise, contains considerably more information on the vegetation and general geography than previous guides. There is a sketch of the geography and history of each of the states and much information on the significance and origin of place names. A great deal of the purely geologic matter is relegated to footnotes.

The professional geologist and geographer will find in the guide material not easily accessible in print and moderate amounts of new material, especially on southern Arizona and New Mexico. Except for these local details, the bulk of the information is drawn from published works of Mr. Darton and others or has appeared in the guidebooks of the Sixteenth International Geological Congress. The nontechnical reader will find the guide readable and interesting. The text has continuity and should not be so fatiguing as that of some of the earlier guides. Something of the romance of the Southwest, of the wide sweep of its plains and the

fragrance of its desert flowers, has found its way into this book—a credit to the taste of its author and the experience of the honorable scientific organization that is its sponsor.

KIRK BRYAN

THE PHYSIOGRAPHY OF ICELAND

NIELS NIELSEN. **Contributions to the Physiography of Iceland, with Particular Reference to the Highlands West of Vatnajökull.** 105 pp.; maps, diagrs., ills., bibliogr. *Mémoires Acad. Royale des Sci. et des Lettres de Danemark, Sect. des Sci.*, Ser. 9, Vol. 4, No. 5, Copenhagen, 1933, pp. 183–287.

It was a misfortune for Iceland and for everyone interested in that country that the magnificent topographic survey of the Danish General Staff was uncompleted when Iceland undertook to manage her own affairs. The writer, however, has been informed by Dr. Nielsen that the topographic survey of Iceland has been resumed and that it will be completed in about ten years. On the Danish map a large part of the coastal region of Iceland is represented on a scale of 1 : 50,000, with relief and culture and every conspicuous crater and fissure, lava flow, and sand waste clearly and accurately indicated. The cartography of vast tracts of the interior highlands still rests, however, on the reconnaissance survey of Björn Gunnlaugsson (1831–1843) supplemented by the scattered observations and corrections of later scientific travelers. It is not surprising, therefore, that even the simple instrumental means used by Dr. Nielsen in his season's work (1927) in the interior belt stretching northeastward from Hekla, between the Túngná and the Kaldakvísl, to the southwest extremity of Túngnáfellsjökull revealed serious errors in the position and extent of important topographic features as represented on the best available topographic map (the geological map of Th. Thoroddsen, 1 : 600,000, Copenhagen, 1901).

Among the more striking discrepancies discovered by Dr. Nielsen are: the greatly overrated size of the highland ice fields (about 100 per cent in the case of Hofsjökull, hitherto regarded as second to Vatnajökull in size) and the correspondingly underestimated extent of the intervening plateaus; misplacement of the main streams; faulty representation of Thórisvatn (the next largest lake in Iceland after Thingvallavatn); and erroneous mapping of the lake group Fiskivötn, which seems to have been based on hearsay rather than on observation. Dr. Nielsen's cartographical corrections are corroborated in part by the later work of Oetting (discussed in the *Geographical Review*, Vol. 21, 1931, p. 700).

The tectonics of Iceland are clearly tensional tectonics whereby the plateau has been rent along well defined southwest-northeast and south-north lines that are also the main lines of volcanic activity. Differential subsidence without important tilting has defined the basic relief. Crustal movement and volcanic activity are evidently closely related, and where these internal forces have been recently active the harsh fault features and the barren accumulations of lavas and cinders provide the key to the understanding of the maturer Icelandic landscapes molded by the less recently interrupted action of external forces.

The surface forms of Iceland are the result of the action of mechanical, glacial, fluvial, and aeolian processes on the dislocated plateau of volcanic accumulations and glacial deposits. Wholly unlike the conditions prevailing in a typical humid region, where a stable land mass is continuously molded by relatively constant fluvial erosion, the destructive agents in Iceland are strongly seasonal in character, the tectonic processes are constantly active, and the terrain is a plateau intermittently repairing itself with both solid and liquid volcanic products from extended fissures, lines of coactive vents, and areas of essentially contemporaneous mass eruption.

During the long Icelandic winter mechanical disintegration is active, but the snow mantle tends to check degradation. In the spring rapid melting gives rise to violent solifluction and a short period of vigorous fluvial denudation. With the

advance of summer the smaller streams dry up and vanish in the porous ground, and the widespread silt and ash are caught and scattered by violent gales that scour the landscape and destroy the feeble growth of vegetation, except in the few oases that persist in sheltered areas with adequate water economy.

Dr. Nielsen's memoir on about half a square degree of the little known interior of Iceland gives lucid descriptions and able discussions of the physical geography of the region. Covering a wide variety of problems, Dr. Nielsen reaches some conclusions that seem to be insufficiently supported by observation or argument. "The great north-country fjords must likewise be taken to be subsidence areas, whereas the peninsulas lying between them may be regarded as areas of resistance" (p. 100). This allows the reader to suppose that Dr. Nielsen advocates the hardly tenable thesis that the fiords are essentially rift valleys. Discussing the association of postglacial basaltic and "liparitic" (trachyrhyolitic) lavas in Landmannaafrjettur, Dr. Nielsen's bald restatement of Bunsen's primitive petrological theory that "there must be two magma-containers under this terrain, one basaltic and the other liparitic," (pp. 51–52) is unjustified without elaboration. The claim that Háganga sydhri is a unique example of a liparitic *Staukuppe* (lava dome) in Iceland (p. 54) is surprising: the reviewer recalls similar craterless liparitic mountains built in some degree of effusive types, whose upper parts, at least, are better understood as extrusive domes than as denuded intrusive stocks.

Apart from some overwordy discussions leading to conclusions that are already fairly well accepted, Dr. Nielsen offers a valuable and readable contribution to Icelandic geomorphology. The reader is assisted by numerous summary statements, several able schemes of classification, such as those relating to lakes, seasonal denudation, and oases, and a series of well chosen photographs. In his insistence on the tectonic and volcanic control of relief in Iceland, Dr. Nielsen is rightly, in the reviewer's opinion, in opposition to Dr. Oetting, who concluded that differential erosion is the dominating relief-forming process in the interior.

M. A. Peacock

The Soils of India

Z. J. Schokalsky. **The Natural Conditions of Soil Formation in India.** Maps, diagrs., bibliogr. *Contributions to the Knowledge of the Soils of Asia, 2*, Academy of Sciences of the U. S. S. R., Dokuchaiev Institute of Soil Science, Leningrad, 1932, pp. 53–155. 10 x 7 inches.

Information on the soils of India has been gathered almost exclusively from the agronomic point of view, i.e. of the soil as a producer of plants. In this paper Mlle. Schokalsky essays to examine them from the pedological viewpoint, i.e. of the soil as a natural body, the product of dynamic forces, mainly climate and organic life, acting on the local geological material. So few pedological data are available that the study of Indian soils from this angle must be approached indirectly.

Consideration of the climatic, biologic, physiographic, and geologic conditions permits a subdivision of the country into unit areas defined on the basis of given associations of these conditions. From this may be made an interpretation of the probable result of the action of each of such associations of forces and conditions in the production of soils within the area of its occurrence. This must be based on a knowledge of the effect of identical or similar associations and conditions elsewhere, especially difficult for a tropical country, since well worked-out correlations of tropical environments and the many possible kinds of geological materials with well defined soil characteristics are very few in number and range.

Although it is not possible as yet satisfactorily to differentiate the soil groups of India and identify them as members of the great soil groups of the world now well defined for at least the temperate zone of the northern hemisphere, Mlle. Schokal-

sky's paper constitutes an important starting point and basis for further work. We may comment on one or two points by way of illustration. The great Indo-Gangetic alluvial plain is presented as a region, except along the lower parts of the rivers, of relatively old alluvium into which the existing valleys of moderate width have been excavated. The old alluvium is considered old enough for the development of a soil in harmony with the climatic and vegetational environment, these broad soil areas from east to west in the sub-Himalayan plain being (1) soils of the relatively humid steppes or prairies; (2) soils of the subtropical dry steppes; and (3) soils of the gray desert type. Number 2 is not designated as chernozem because it is not black, though climatically that is where it would belong.

Laterites have been given a great deal of attention and in general soil literature have hitherto been given status as soils. The author of this paper, however, brings out clearly that laterite is a geological formation and not a soil, being a product of the geological processes of rock decay. There is no more reason to designate such a product as soil than to designate a kaolinitic-weathering product as soil. This viewpoint is sound and logical, but it entails certain consequences that, however, are not pointed out by Mlle. Schokalsky and have not yet gained universal recognition by pedologists. If laterite is a geological product constituting only that soil material on which more than one soil type may be developed, it follows as a necessary consequence that the soil, expressed in what is now universally recognized as the soil profile, is not directly a product of climate but necessarily of organic life, the other of the two dynamic forces acting on consolidated rocks at the earth's surface (see "Explorations in Science," Research Laboratory, General Electric Company, 1933).

The most widely known soil in India is the regur or black cotton soil. Its existence has been known for many years and has excited the curiosity of pedologists the world over. Its distribution, though necessarily only approximately, is shown by Mlle. Schokalsky seemingly for the first time on a map. She discusses the problem of its development, but her conclusions are necessarily based on the available data, and these seem to be insufficient to warrant a definite conclusion regarding all its phases. Her discussion will be welcomed by pedologists of the English-speaking countries as the fullest description in print.

C. F. MARBUT

PRESENTING THE WEATHER

SIR NAPIER SHAW. **The Drama of Weather.** xiv and 269 pp.; maps, diagrs., ills., index. University Press, Cambridge, England; The Macmillan Company, New York, 1933. $3.50. 8½ x 6 inches.

A recent report of the Science Advisory Board dealt with the operations and the improvement of the United States Weather Bureau. One of the principal recommendations was the greater use of modern methods of air-mass analysis in forecasting. For those who wish to understand the theory and the physics involved and yet avoid the details of analysis no better reference can be recommended than Sir Napier Shaw's "The Drama of Weather."

Everyone interested in the study of weather is tempted or accustomed to take a day off when a new book by Shaw arrives on the scene. Not only can he make things clear but he enlivens every page with an imagery both pleasing and instructive and every diagram and table of statistics with ingenious interpretation. He is always the master who can play with his subject as well as expound it. His latest book is par excellence the layman's meteorology.

Because forecast is the practical object of meteorological science, we confine our comments to this single aspect. The point of view of our author is well shown in the Preface. "Due respect is inevitably paid to the weather-map as a help in answering the question, 'Will it rain to-morrow?'. It has thrilled humanity throughout the

ages; but the reader will be forgiven if he finds that the text of the discourse points to the question, 'Why did it rain yesterday?' as one which is worthy of attention." After an analysis of rhythms—the day, the week, the month, the year, the group of years—with really striking and informing diagrams, he concludes that "it would be something in the nature of a miracle if so powerful an agency [the sun] left no trace of the sequence of its changes upon the condition of the atmosphere. Anything on the earth which proved to be independent of day and night and of summer and winter would certainly deserve to be called supernatural." And finally of cycles he says: "They are good enough to guide one's general examination of the sequence of events but not sufficiently dominant to tell us what will happen next winter." He adds: "It takes a wiser man to appreciate them at their real value than it does to make them" and "for the student of weather as for the student of history the differences in cause or effect which are marked by precision are always important and sometimes more important than the apparent similarities. It may, accordingly, be best to regard our rhythms and our coefficients as poetic illustrations of the meaning of our facts and not as substitutes for them." The use of predictions derived by harmonic analysis or correlation suggests to "wise persons certain possibilities of relationship for closer investigation," and he thinks it unwise to publish in the press predictions based upon the method without at the same time including so many cautions and "howevers" that the "man-in-the-street" will be disposed "to write it all down as mere words."

This changing atmosphere of ours is one of the "ways of the world" that an intelligent man wishes to understand; as far as science can now help him so to do, he can turn to Shaw's pageantry, graphs, and good-humored but wise and cautious text for a reliable and always lively account of the present state of affairs.

The Peoples of the Philippines

Siegfried Lenk. **Die Bevölkerung der Philippinen: Eine anthropogeographische Untersuchung.** 155 pp.; maps, diagrs., bibliogr. (Inaug. Diss., Leipzig.) Frommhold & Wendler, Leipzig, 1932. 9 x 6 inches.

This remarkable doctoral dissertation should be translated into English and widely circulated in the United States. Whether the Filipinos are ready for independence, its author says, is eagerly argued pro and con in the United States and in Germany just as passionately, but always pro! The matter is made one of politics. Dr. Lenk attempts most successfully to treat it geographically and give us a picture of the Filipinos and their land.

He is sympathetic to the United States, praises strongly the spirit in which America has striven and often succeeded in improving education, sanitation, culture, and economic conditions for all the people of the islands—in which, says he, lie our "rights" in the islands. Oddly, in mentioning our conquest of the islands by force, he makes no mention of a war for Cuba and a battle with a sort of Spanish fleet at Manila, which was our only occasion to have any Philippine affairs.

The book paints brilliant pictures of island landscapes and resources. We pick out here from the mass of details the answer to the question: "Who are the Filipinos?" Not 87 different and hostile tribes of savages but substantially four racial groups: 56,000 woolly-headed, dwarf, black Negritos, savages in the mountain forests, living from what they can pick up; 225,000 Igorots, with smooth black hair, "yellowish copper-brown" skins, and oblique black eyes, mountain dwellers recently induced to lay aside their favorite sport of head-hunting; 650,000 Moros, Mohammedans of the south, not so long since pirates, and very conscious that in personal combat they are more than a match for the Christian natives; 9,380,000 "Christian" Filipinos, with considerable civilization and numbering many tribes, whose distinctions, however, have been overemphasized.

But more important for the question is the social grouping into *caciques* and *taos*. The taos are the working people, the people who carry on the culture of the Filipinos. Many of them are ignorant—half the population of the islands is still unable to read and write and most of them cannot speak Spanish. The caciques are some six or seven per cent of the islanders, mostly Spanish creoles or mestizos. They read and write, and all have had some schooling. They dress and live more in the European fashion than any other group of Filipinos. Miss Mayo has said of them that the cacique "has one occupation—politics, one industry—usury, and one hobby—gambling." Under Spain, control was in the hands of the priests; now the caciques own property and control the affairs of the islands under the protection of American power. The attitude of cacique to tao is the thorny question of Philippine independence.

MARK JEFFERSON

PUERTO RICO: THE GEOLOGICAL FACTS

HOWARD A. MEYERHOFF. **Geology of Puerto Rico.** 306 pp.; maps, diagrs., ills., bibliogr., index. (Monographs of the Univ. of Puerto Rico, Ser. B, No. 1.) [Río Piedras, P.R.], 1933. 9½ x 6 inches.

In conjunction with Colonel Roosevelt's article on Puerto Rico and the Philippines (see pp. 182–204) attention may be called to the above monograph received as this number of the *Geographical Review* is about to go to press. Dr. Meyerhoff's work on West Indian geology and physiography is already favorably known. The present volume has grown out of a series of lectures given as visiting professor to the University of Puerto Rico, 1931–1932. Thanks to the studies initiated by the New York Academy of Sciences in 1914 and carried out in conjunction with the insular government, Puerto Rico today is better known geologically than any other of the islands of the West Indies. Important problems await solution, but the general outline can be sketched. This Dr. Meyerhoff does in the following sequence: geological background, geological history (volcanic core, ancient mountains, coastal plain, present form), geological materials (note especially the section on soils, pp. 142–155), geological present ("winds, rains, streams, and sea . . . working upon a tilted block, which is still unstable"), geological problems.

The Caribbean lands hold an extremely important place in the dynamic and structural geology of the Americas, but in his conclusion it is the practical aspects that Dr. Meyerhoff stresses: "In the economic structure of the future, the geologist has much more to offer than an interesting tale of the past." An excellently clear and readable geological map on a scale of approximately 1 : 280,000 and a useful bibliography accompany the monograph.

A NEW EDITION OF DARWIN'S DIARY ON THE "BEAGLE"

Charles Darwin's **Diary of the Voyage of H.M.S. "Beagle."** Edited from the MS by Nora Barlow. xxx and 451 pp.; maps, ills., bibliogr., index. The Macmillan Company, New York; University Press, Cambridge, England, 1933. $6.50. 9½ x 6½ inches.

A new and complete edition of Darwin's diary on the *Beagle* celebrates the centenary of his five-year voyage. The first edition contained 224,000 words; its first and second issues appeared in 1839, the third in 1840. A second edition of 213,000 words came out in 1845, a third in 1860, and a fourth in 1870. In all these about a third of the original manuscript of 189,000 words was omitted; but the omissions were more than made good, as to quantity, by additions of a scientific nature taken from geological and zoölogical record books, which had a total of more than 2000 pages. These, like the diary, were expanded during the long voyage from con-

densed notes in small pocketbooks carried on land journeys; for example: "Twiners entwining twiners,—tresses like hair,—beautiful lepidoptera,—silence—hosannah;—Frog habits like toad—slow jumps,—Sublime devotion the prevalent feeling."

The present verbatim edition, prepared by Darwin's granddaughter, Mrs. Nora Barlow, daughter of his youngest son, Horace, is therefore less of scientific than of personal interest; but Darwin holds so preëminent a position in the world of thought that even the personal details of his epoch-making voyage are now of historic import. (The more significant passages previously omitted are conveniently tabulated on pp. 441–442.) As the editor well says: "To many readers Charles Darwin stands as a figure far advanced both in knowledge and in years; this volume contains a picture of him in the first freshness and eager enjoyment of life." It must never be forgotten that he was only twenty-two when he embarked. But the volume gives far more than that picture. It shows his brave devotion to duty under conditions that were often fatiguing, even exhausting; and it shows also his inborn diffidence of his own extraordinary powers. An early letter sent back to his doubting father said: ". . . I am incessantly occupied by new & most interesting animals . . . I think—if I can so soon judge, I shall be able to do some original work . . ." His distrust of the effect his diary might have when its first part was sent home within a year from his departure was told in a letter, to which was added, "Recollect how tired I generally am when writing it."

The editor notes that the construction, grammar, and spelling of the original manuscript are preserved. Heterographers may therefore feel consolation in such words as "broard," "derth," "chace," "yatch," "cannabals," "Yankeys," and "Portugeese." Here are found also records of the young naturalist's seasickness, which was recurrent nearly every time the *Beagle* put to sea after a stay in port and so severe that it affected his health in later years.

The most important scientific item of the book not previously published gives an account (August 5, 1834) of walks near Valparaiso, where beds of recent shells were found up to an altitude of 1300 feet, but where "very few quadrupeds" were seen. To this was added: "It seems not a very improbable conjecture that the want of animals may be owing to none having been created [here] since this country was raised from the sea." Darwin was then a special creationist! Had this young man remained at home, as his father at first advised, his almost fixed purpose of becoming a clergyman would probably have been accomplished. Even after five months at sea he wrote: "I find I steadily have a distant prospect of a very quiet parsonage"; but his life was so differently ordered that instead of preaching a conventional theology to a willing parish he taught a new philosophy to an unwilling world.

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